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ABSTRACT
                   This document presents witness testimony and
supplemental materials from a Congressional hearing called to assess
the effectiveness of federally funded educational technology
programs, particularly Technology for Education, Star Schools, Ready
to Learn Television, and Mathline. Other educational technologies
were introduced at the hearing as well, so that all could be
prioritized in light of new presidential budget requests. Senators
whose remarks or questions comprise part of the document include Thad
Cochran, James Jeffords, Ernest Hollings, and Mark Hatfield. Other
witnesses include: (1) Madeleine Kunin, Department of Education; (2)
Tom Burnham, Mississippi superintendent of education; (3) Gary Vance,
Satellite Educational Resources Consortium; (4) Walt Hindenlang,
Hughes Electronics Galaxy Institute for Education; (5) Benito
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Carolyn Reid-Wallace, Corporation for Public Broadcasting; (7) Joy
Rouse, St. Louis County, Missouri Board of Education; (8) Beryl
Jackson, PBS Mathline; (9) Joan Miller, West Sylvan Middle School,
Portland, Oregon; (10) Margaret G. Kelly, International Society for
Technology in Education; (11) Jeanne Hayes, Quality Education Data;
(12) Anne Miller, Eastmen Kodak Co.; (13) Kathleen Fulton, Office of
Technology Assessment; (14) Linda Morra, General Accounting Office;
and (15) John Cradler. (Contains 30 tables.) (BEW)

EDUCATIONAL TECHNOLOGY

HEARING

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

UNITED STATES SENATE

ONE HUNDRED FOURTH CONGRESS

FIRST SESSION

SPECIAL HEARING

Printed for the use of the Committee on Appropriations

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EDUCATIONAL TECHNOLOGY

TUESDAY, APRIL 4, 1995

U.S. SENATE,
SUBCOMMITTEE ON LABOR, HEALTH AND HUMAN
SERVICES, AND EDUCATION, AND RELATED AGENCIES,
COMMITTEE ON APPROPRIATIONS,
Washington, DC.

The subcommittee met at 9:42 a.m., in room SD–192, Dirksen
Senate Office Building, Hon. Thad Cochran presiding.
Present: Senators Cochran, Hatfield, Jeffords, and Bumpers.

DEPARTMENT OF EDUCATION

OFFICE OF THE SECRETARY OF EDUCATION

STATEMENT OF HON. MADELEINE KUNIN, DEPUTY SECRETARY
ACCOMPANIED BY:
 SHARON ROBINSON, ASSISTANT SECRETARY, OFFICE OF EDU-
 CATIONAL RESEARCH AND IMPROVEMENT
 LINDA ROBERTS, SPECIAL ADVISOR, EDUCATION TECHNOLOGY

OPENING REMARKS OF SENATOR THAD COCHRAN

Senator COCHRAN. The committee will please come to order.
This morning we are very pleased to begin a special hearing of
the Labor, Health and Human Services, and Education, and Relat-
ed Agencies Appropriations Subcommittee to look at the effective-
ness of educational technology programs that are funded by the
Federal Government.

This hearing will concentrate on four programs, Technology for
Education, Star Schools, Ready to Learn Television, and Mathline,
all of which are authorized under the Improving America's Schools,
Elementary and Secondary Act.

We will also be learning about other programs that support the
integration of technology in the classroom. This hearing is designed
to evaluate the budget request that is submitted by the President
for funding various technology education programs.

As everyone knows, there is a tremendous amount of pressure on
the budget because of the increasing Federal deficit that we see in
the operating budget each year. The President's budget request
projects an increase in the operating deficit from about $192 billion
to $196 billion next year.

So this is a problem that we have to keep in mind. And that is
another reason why this hearing, in my view, is so important.

We will try to determine where the priorities ought to be for Fed-
eral spending in these technology programs. We want to be sure

(1)

that our classrooms throughout the country, irrespective of their abilities to finance purchases of equipment and the like that are associated with these emerging technologies, will have the re- sources to make available to students these opportunities that are being developed throughout the country.

There have been some very innovative and imaginative thing happening in this area, and I think the Senate will benefit from this hearing record that we will develop today.

Let me, without delaying the hearing any further with my com- ments, call our first witnesses.

SUMMARY STATEMENT OF MADELEINE KUNIN

Our first witness is the Department of Education, represented by Ms. Madeleine Kunin, who is Deputy Secretary of Education. She is accompanied by Assistant Secretary for the Office of Educational Research and Improvement, Dr. Sharon Robinson, and Dr. Linda Roberts, Special Advisor to the Secretary for Education Technology.

We appreciate very much your being here this morning, and as you have probably already been advised by staff, we do have a lot of witnesses and a lot of subjects we are going to cover, and we are asking every witness to limit their statement to 5 minutes.

Thank you very much. You may proceed.

Ms. KUNIN. Thank you very much, Senator. It is a great pleasure to have this opportunity to appear before you and your committee.

As you indicated, with me are Sharon Robinson and Linda Rob- erts, two experts in this field as well. For the record, I am submit- ting written testimony, and will just make some brief oral remarks right now.

The basic purpose of our remarks is to really examine, as you in- dicated, what is the most appropriate role for the Federal Govern- ment in this field. It was only 2 years ago, a very short time, in some ways, that the U.S. Department of Education was noted more by its absence than by its presence in the field of technology and education.

Today, what has changed is that education has a seat at the table at the Federal level, and is becoming sought after as a useful partner by States and by communities, thanks, in part, to your support and encouragement of these efforts, and also, in large part, to the rapidly growing demand for information, for the latest deci- sions about what works, what is effective in the classroom.

So we are working with our constituencies in figuring out how we can most appropriately meet their needs.

Our task, as you noted, with the budget deficit, is to use our lim- ited resources in the most targeted and effective way, so that we can not only meet the technology needs of this country, but also meet the over-arching mission of the U.S. Department of Edu- cation, which is to improve access to high-quality education for all of America's school children.

In some respects, the Department is a late comer to this discus- sion, because many States are really far ahead of us, in both the time and the money they have spent on technology. But in other respects, our timing is very appropriate, because we now know how to fill the unmet needs, not as we define them, but in response to our own customers, the communities, and the States around this

country, so we can help further their education agenda as they define it.

The list which I described is not the list of our own making, the list of where we see the Federal priorities, it is really derived from the feedback that we have received from educators and from private sector individuals at the State and local level.

And these are some of the things they would like us to do, which we have begun to do, in order to help them educate their children most effectively.

One, and it is the greatest question of all, is to create greater equity between affluent and poor rural school districts, by addressing some of the disparities in access, and figuring out how to have less of a division between rich and poor in this area.

As you so well know from your own work, we have an opportunity through technology to create greater equity, but we also have the parallel danger of increasing the disparity if we do not do it right.

One example of how the Federal Government can play a major role is, for example, through the Federal Communications Commission. We had legislation pending to provide access, hopefully, at cost, or at least in an affordable manner.

Another major Federal responsibility is to support planning and building partnerships within States. Oddly enough, we can be the catalysts to make the different States communicate more with one another.

The vehicle for that has been Goals 2000, where 44 States have already developed plans involving their own stakeholders in developing a common strategy.

For example, the chief States school officer, Wayne Sansaid, in North Dakota, has used this planning process to bring together 189 school districts into regional consortia, really linking technology to education in reform plans in his own State.

A third area where we have had many requests for assistance is plain old technical assistance and professional development.

The way we are addressing that very strong need is through the technology consortia, a very innovative, interesting model that brings together the experts in the region to help schools make the right choices for themselves. We expect some 250,000 teachers to be affected by these consortia at the outset.

And fourth, the Federal Government has the great capacity in all areas, and certainly it is significant in this area, to be a convener, and to help States learn from one another by bringing them together.

And because this is all such new information, constantly changing information, it is a very important role. And, of course, we also support and promote cutting-edge research.

The success of our convening authority was evidenced by the two conferences we have held with 50 States, where they brought teams. We really felt the energy and excitement in the room. And lots of new ideas were disseminated across the country as a result of our bringing these people together in Washington, and having them learn from one another, as much as they did from our expertise.

The final, but it is not truly the end of the list, only time forces me to limit it here, is that we are playing a role in stimulating the development of software related to academic standards.

This is, again, a gap of edutainment. Private sector usage of educational software is flourishing. The same cannot be said of the really hard stuff that is related to educational standards. And, again, our funding is geared toward leveraging that kind of investment.

I would like to conclude by pointing out two more things. One indication of the power of technology in education became clear to me when I attended a conference on super computers, and the children attended this conference in teams, with high school students, high school teachers, and college professors.

What struck me was that it was not a hierarchy, with the college professor being the most knowledgeable, and then the high school teacher, and then the high school student.

In fact, when I questioned them, they all learned from one another, and the usual hierarchy and the usual barriers that exist between different levels of expertise suddenly just crumbled and disappeared.

I think what technology can do in a most powerful way is end the isolation and categorization of the public school teacher.

The public school teacher can now be on equal standing with the college professor, can have access to the same kind of knowledge. And students can go up and down this hierarchy according to their ability to learn, so that now the high school teacher is part of a larger community of learning, as is the student.

So the first time we have the possibility of breaking down the walls of a closed-door classroom, the walls on knowledge, once limited to certain people and to certain geographic areas, are all coming down.

PREPARED STATEMENT

Not only does this phenomenon have huge implications for how we learn, but also for who is in control of knowledge and who can learn. The end of public classroom isolation has tremendous implications for school improvement itself.

It means everyone can truly achieve his or her greatest potential and learn to high standards.

[The statement follows:]

STATEMENT OF MADELEINE KUNIN

Mr. Chairman and Members of the Committee:

Thank you for this opportunity to appear before the Subcommittee. I am here to discuss federal funding for programs that support the integration of advanced technologies into the nation's elementary and secondary schools.

The nation is experiencing a scientific and technological revolution of unprecedented proportions. Everywhere we look, information technology is changing the way we work and live -- everywhere, that is, but in our classrooms.

The Secretary and I believe that technology can serve as a vehicle for improving student achievement, providing more equitable access to educational opportunities, and bringing about fundamental improvements in education. Advancing technology use is central to the Department's mission of equity and excellence, and we are giving it a high priority. We have already achieved significant success in advancing technology use, and the appropriations we are requesting in FY 1996 and future years will help to accelerate further improvements that benefit all our nation's learners.

Last year, Vice President Gore challenged industry to wire every classroom to the Information Superhighway by the year 2000. It is a daunting challenge, as only 3 percent of classrooms are connected today. Dozens of states and hundreds of school districts have set equally ambitious goals, aimed at enhancing the effectiveness of schools and preparing our youth to live and work in the "Information Era."

Achieving these goals will come about largely through the efforts of state and local government and the private sector. However, progress can be greatly accelerated if the federal government provides some support for this work. Our contribution is to support state, local district, and school innovations, to advocate broadly for schools' access to new technologies, and to ensure that the increased use of technology benefits all learners Appropriations of $79 million in FY 1995 and $122 million in FY 1996 are long-term investments that will enable the Department to help initiate these important changes in schools. (Please see attached table.)

In the FY 1995 budget, Congress appropriated $49 million in new funding which, combined with the Star Schools program and other Department efforts, constitutes our technology initiative. The Office of Educational Technology, ably led by Dr. Linda G. Roberts, is charged with pulling these activities together into a coherent effort and providing national leadership and visibility.

I should note that the Department has already accumulated a record of significant achievement in advancing technology usage. Since 1988, for example, the Star Schools program has made distance learning (instruction delivered over distances by network or satellite) an established instructional method, especially in rural and urban schools with little access to educational resources. This school year, several million children will participate in distance instruction, many through programs now supported by a Star Schools grant or through programs that have received support in the past from Star Schools. Investments in R&D for disabled learners have resulted in a range of powerful new technology-based instructional tools. In the last year, the Department has provided considerable assistance to states and communities seeking to increase technology use, and has become a leader in providing services for educators over the Internet.

TECHNOLOGY'S IMPORTANCE TO SCHOOL IMPROVEMENT

Perhaps the least heralded, but most important advantages of technology is its effect on the function and status of teachers. At a recent conference on high-performance computing here in Washington, I asked a teacher how she had come up to speed on all this technology. She said, "oh, they teach me," pointing to her students.

Something radical is occurring. The lines of hierarchy between teacher and student are becoming blurred. The isolation of the teacher is broken down as technology is being used as a tool of communication in a common language. Knowledge once limited to certain areas and individuals is becoming more widely available. This phenomenon has huge consequences for how students learn, who is in control, and who can learn -- and for school improvement itself

Goals 2000, the nation's strategy for meeting the eight National Education Goals, asks us to hold all our children to high standards of achievement. The law provides resources for states and school districts as they develop new, high standards for what students should know and for planning to help focus all educational efforts on reaching these standards. These new standards being developed by states are ambitious indeed, and they challenge all our students to perform at levels now expected only of our best students. Technology can help many more of our students meet these high standards.

Effective uses of technology in educational settings include supporting administrative tasks like storing student records, bridging distances through interactive video and data networks; skills acquisition, such as helping kids master pronunciation and spelling; developing writing skills; and simulating complex tasks such as managing a stock portfolio. In all of these cases, technology enables tasks to be tailored to the user's speed, skill level, and interests, increases interactions with others, and provides access to more information

Results from schools around the country and from research indicate that technology does help students meet high standards Comparisons of interactive video instruction and the most basic types of computer-based instruction and with more traditional instructional formats indicate that these methods are as much as 30 percent more effective Research on students with disabilities has indicated that almost three-quarters of school-age children with disabilities were able to remain in a regular classroom and 45 percent were able to reduce school-related services through the use of telecommunications and other technologies

Furthermore, projects around the country like the Christopher Columbus Middle School in Union City, N J , the Val Verde School District in California, and the Science Collaboration Project ("Co-Vis") between high schools in Illinois and scientists at Northwestern University have reported results such as dramatic increases in test scores, decreases in teacher and student absenteeism, increases in the time devoted by students to academic subjects, success in awakening interest in students who have not responded to traditional instruction, and important learning experiences for students interacting with other students, teachers, and professionals around the world Based on the results of research and projects like these across the country, there is a compelling case for teachers and learners to have full access to technological tools

It is important to recognize that not all schools have applied technology to education with equal success Common features of many successful schools are worth mentioning: first, there is a plan that defines what the technology is to do, what it will cost, and how it fits into teachers' instructional strategies Second, the preparation of teachers to use these technologies is given high priority. Third, investments in hardware and software are matched by spending for staff development and on-site technical support Fourth, computers are connected to each other via local area networks, and to the outside world via the Internet, to increase productivity and access to information And finally, technology is treated in these schools as an instructional tool just like the blackboard and textbooks, and therefore is present in every classroom, not just in a computer lab, library or media center

The cost-effectiveness of technology is more difficult to measure Impressive learning gains have been documented by researchers, yet many other important educational results are difficult to quantify. The research results, combined with technology's power to expand learning time beyond the traditional school day, suggests significant long-term value, but implementing technology can consume three percent or more of the educational budget This represents a large fraction of non-personnel costs Furthermore, technology implementation is difficult, and improvements in student performance are hardly automatic

Still, it is important to point out that the private sector continues to make massive investments in information technologies because they contribute to profitability and are necessary to keep up with competitive pressures. Schools should heed this significant trend.

Aside from its effects on learning, another reason for giving all students access to advanced technology is the direction of the American economy. Most new high-paying jobs require skills in finding, analyzing, and manipulating information, and information technologies play an important role in keeping U.S. businesses competitive in world markets. The *Wall Street Journal* reported recently that these technologies are essential to many industries, and "sophisticated computer networks. have become information factories that speed innovation and compress product cycles . American companies are their undisputed masters."[1] Many American parents rightly believe that students who are adept users of information technology have a leg up in a highly competitive job market. In addition, technology enables many individuals with disabilities to work and become productive citizens

Giving our students access is important not just to help them today but also to build a nation of learners who are prepared to use information for their entire lifetimes. The private sector should be looking to develop a future market of Americans who will use new telecommunications resources, not just looking to make a profit from selling services to schools. If we provide connections to the schools today, the payoff in the future will be very great, especially for telecommunications firms.

HOW TECHNOLOGY WILL BECOME PART OF EDUCATION

The integration of technology into education will depend largely upon state and local governments and the private sector. State and local governments provide over 93 percent of the nation's investment in elementary and secondary education. Accordingly, most of the spending on hardware, software, professional development and support services will come from state and local public funds. Many states and school districts are now developing or implementing technology plans. Yet districts have few sources of independent, objective advice and support for technology implementation. Moreover, a recent survey completed by the National Center for Education Statistics indicated that while 35 percent of school buildings have some connection to the Internet, only 3 percent of classrooms are connected. A few schools have moved to make technology available widely in school buildings; the great majority have not.

Broadly speaking, the private sector's role is to provide telecommunications services and applications for education and lifelong learning. The private sector will build the telecommunications infrastructure, for example, Pacific Bell has committed to providing data links for all California schools, colleges, and universities. The private sector will also make a large share of the nation's investments in software and applications development for education and lifelong learning. So far, most private sector R&D is being invested in the development of entertainment software rather than in high-quality software that supports instruction

FEDERAL LEADERSHIP IN TECHNOLOGY FOR EDUCATION

Despite the work being done by states, local educators, and the private sector, the Department's discussions with educators over the last two years indicate that at least four significant barriers to more widespread and effective use of technology in education persist

While computers are found in almost every school regardless of per-pupil expenditures, the most advanced uses of technology have made it into all too few schools. Poor and rural schools in particular will continue to face enormous hurdles to technology implementation

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[1] *Wall Street Journal*, "High-Tech Edge Gives U S. Firms Global Lead in Computer Networks," September 9, 1994, p. 1

Second, the great majority of teachers do not have the expertise to make greater use of technology in their classrooms, nor do they have time to learn in the school day's hectic schedule. Until teachers have more opportunities to develop these skills, no amount of hardware and software will make a difference.

Third, computer technology is complex and changes rapidly, so states and school districts need ongoing assistance to plan for and implement technology. School districts typically rely on hardware and software vendors to help them make decisions about technology usage. Few districts have access to more objective advice to guide their decisions. As a result, they rarely benefit from the experience of other states and districts or from research.

Finally, while software developers have invested substantial sums in the development of products designed to entertain, they have not paid as much attention to the school market. If developers have incentives to develop state-of-the-art educational products along with the plethora of games and business applications, our learners will benefit considerably.

At the Secretary's Conference on Educational Technology last month, teams of educators from all 50 states with responsibility for technology planning and implementation were asked what the Department could do to support greater technology usage The recommendations fell into four basic categories.

First, they asked that the Department provide technical assistance and successful models in areas such as school connectivity and infrastructure, professional development methods, creating partnerships with the private sector and communities, financing technology, assessing technology's impact, and integrating technology into curriculum and classroom practice.

They also asked that the Department provide policy guidance and leadership in areas like interoperability standards, professional development standards, equitable access, sharing information between states, acceptable use policies and practices, and public awareness.

And they asked the Department to provide funding for ongoing technology planning, assessing projects and programs, and research on how technology increases learning.

THE DEPARTMENT'S TECHNOLOGY INITIATIVE

The Department has the capacity to accomplish many of these tasks. It is working to expand access to technology for all students, not just the students in leading-edge districts. It supports planning at the state and local levels. It helps educators to learn from the experience of successful schools and districts and from research. It supports on-going technical assistance for states and districts It can support the development of research and new technologies that help learners And it can ensure that all federal programs and policies broadly support the infusion of technology into schools. The Department's technology initiative focuses on these activities.

The Secretary will release a national, long-range plan for the use of technology in education in September, 1995. This plan will be a national vision statement on how technology can improve learning It will be released after extensive dialogue with educators, experts, representatives of state and local government, the private sector, and the public. The plan will describe a federal course of action, actions underway at state, local, and school levels, and efforts undertaken by the private sector.

In the meantime, however, we are moving forward with activities that seek to address the needs identified to us by educators

Goals 2000 Planning Grants. A comprehensive approach to improving school performance has to include technology. For this reason, the Department provided support in FY 1994 for planning in the use of technology in education at the state and local district level as part of the Goals 2000 Educate America Act. The Department has provided planning grants to 45 states and the District of Columbia on the use of technology. The Department is also providing technical assistance to states to help them resolve difficult issues raised in the planning process. According to Wayne Sanstead, the North Dakota superintendent of instruction, the Goals 2000 technology grants have enabled his state to link technology planning with the overall reform plans in his state. "we now have 189 districts organized into eleven regional consortia focused on school improvement, and utilizing technology to benefit all students is a major focus of their work." The State of Massachusetts' Five Year Master Plan, developed with partial support from Goals 2000, integrates technology implementation into the plan and describes services and support that the State plans to provide to districts. In Louisiana, the Goals 2000 technology planning grant has brought important stakeholders to the same table to work together, including the state department of education, higher education, public television, the state telecommunications office, and the private sector.

Challenge Grants for Technology in Education. School districts in poor and isolated parts of our nation will have the most difficulty acquiring and using technology. For this reason, Congress appropriated $27 million in competitive grants to support partnerships that include at least one local education agency with a high percentage or number of children living below the poverty line and technology developers, telecommunications service providers, and others who share the dream of helping America enter the 21st century with new technology-supported, high-performance learning environments. Partners may include companies that produce software, schools and businesses, state and local government agencies, libraries and adult learning providers, colleges and universities, telephone and cable companies and others.

Interest in the Challenge Grant program has been extraordinarily high. Before the program was formally announced, the Department received over 1,200 requests for information by mail. Some 35,000 copies of the application package have been mailed out, and since the announcement of the program on March 7, over 1,500 individuals have accessed the electronic copy of the application on the Department's Internet server.

The Challenge Grants are being administered by a task force with members from several agencies. This innovative approach is allowing the Department to leverage the resources of federal agencies and operate the grant program in a cost-effective manner.

The Star Schools Program. In the 1980's, educators began to realize the potential of distance learning to provide educational services to the most underserved areas of the nation. Since 1988, the Star Schools program has served to greatly expand the programming available to educators via distance learning connections. Funded at $30 million in FY 1995, the Star Schools program will provide services including student instructional programming, staff development activities, technical assistance, and dissemination activities for more than one million learners this year. Student programming is being extended for the first time this year to Hawaii, the Pacific Northwest and Puerto Rico. Children residing in Native American communities in the Midwest will receive courses in mathematics, science, foreign languages and workplace literacy. Students in small, rural towns in the South and major urban cities around the country are being stimulated to seek careers in science after participating in engaging hands-on experiments and on-air presentations.

Studies of the program document its overwhelming success at all levels of learning. Special education students participating in the program showed increased improvement in critical thinking and problem solving skills, increased interest in school, and greater confidence in themselves as learners. Limited English proficient students showed significant improvement in content knowledge and skills, increased interest in subjects, improved attendance, and increased efforts to take responsibility for their own learning. Students who

participated in Chapter 1 programs showed statistically significant improvements in language skills, quality of work, and attendance, and higher self-regard. Finally, teachers reported changes in their own methods, such as using different and varied curriculum materials, increased use of cooperative learning strategies, and an increase in the use of multiple technologies in the classroom, including the use of the Internet. These results clearly reflect the need to continue this program as it provides increased opportunities for students to learn and teachers to acquire the needed skills to teach in this communications age

Funding in FY 1995 will be used to continue the second year of grants awarded in 1994. Part of the funding (approximately $3 million) will support a new telecommunications project focusing on increasing high school completion rates and enhancing adult literacy rates

National Conferences. There are many promising efforts now underway in states and communities across the nation, and a key federal role is to facilitate the sharing of ideas and expertise among the nation's educators. In May, 1994, and again in March, 1995, the Secretary convened teams of educators from all 50 states with responsibility for technology planning and implementation. In September, 1994, the Department, the National Science Foundation, and the Department of Commerce jointly sponsored a third conference of state teams -- this time focused solely on building an information infrastructure for the nation's schools. These conferences not only facilitated sharing of information and strategies among the states, they also clarified the areas where the Department and other agencies can provide real assistance in advancing technology use.

Serving Our Customers with Technology. The Department is using the Internet and telecommunications technology aggressively to provide information and services to its customers. Information about Department activities is available through Gopher and World Wide Web servers, a dial-in bulletin board, and through the Department's toll-free number, (800) USA-LEARN. The Department's award-winning AskERIC service enables educators across the country to ask questions and receive answers culled from the resources of the ERIC clearinghouses. The Satellite Town Meeting, a one-hour interactive broadcast, engages thousands of local education leaders every month in dialogue about education reform. On-line forums organized around important policy questions involve hundreds of educators across the country in direct discussions with policymakers. The Direct Student Loan program is enabling colleges and universities to access information and file reports electronically with the Department

Technical Assistance and Professional Development Consortia. Schools and districts have few objective sources of advice and technical assistance for technology. These consortia will provide states and local districts with advice and training for educators, especially teachers, to expand their capacity to use technology in effective ways. The $10 million appropriated for these consortia will expand the reach of organizations that know how to build telecommunications networks, train teachers, and integrate technology into the curriculum. The consortia will also work with colleges of teacher education to improve the knowledge base of pre-service teachers as well. Through direct and indirect services, these consortia will reach ten percent of the nation's 2.5 million teachers every year. Over the next five years, we will provide support to half of the nation's teaching force

Telecommunications Policy. Telecommunications policies made at the national level should be made with the education of children in mind. The Secretary supports affordable, equitable access to knowledge and resources for schools, libraries, and other educational institutions. Telecommunications providers and state public utilities commissions are important partners for schools in providing affordable access. There is tremendous variation in the telecommunications rates paid by schools from state to state, and even within some states. The Department will work with state and local governments to identify ways to ensure affordable access to the information superhighway, and will provide information to states on innovative ways to plan for and finance technology. The Secretary will also work

closely with Congress and with Reed Hundt, Chairman of the Federal Communications Commission, to make telecommunications services affordable to schools and other educational institutions.

Research and Development. Federal R&D should focus more effectively on identifying promising uses of technology for learning. In order to focus the federal investment in research and development for technology in education, four high-priority areas have been initially identified through an interagency planning effort, led by the Department of Education, through the National Science and Technology Council's Committee on Education and Training: (1) research on learning and cognitive processes to improve the understanding of the learning process and how technology can best support that process; (2) new models for evaluating learning and learning productivity, (3) development of high-quality, affordable learning tools and environments for use in a variety of settings including schools, workplaces, and homes, and (4) demonstrations of innovative technology and networking applications on how the information superhighway can be used for advanced instructional systems

In addition, the Department's Office of Educational Research and Improvement (OERI) is developing a long-term R&D agenda that will examine the impact and effectiveness of telecommunications and information technologies in areas such as early childhood development, school achievement, school finance and governance, libraries, and lifelong learning.

Special Education R&D. The Department has a longstanding responsibility to help those who face special challenges to become active participants in learning Over the last five years, the Department has invested $55 million for the development of new tools and methods that help students with disabilities through the use of cutting-edge technology One example is from developers at CAST in Massachusetts They have designed curriculum software that enables a person without motor movements to manipulate the computer screen by nothing more than eye movements. By designing software to meet individual needs of students, these projects can also improve educational results for everyone, including individuals with disabilities

The National Institute on Disability and Rehabilitation Research (NIDRR) within the Department of Education is supporting research and development concerning access to the NII for individuals with disabilities. This research holds the promise of benefitting the educational system at all levels.

Ready-to-Learn Television. This program will support the development of video programming for pre-school and elementary school children and their parents to promote school readiness $7 million has been appropriated in FY 1995.

Telecommunications Demonstration for Mathematics. This program will provide a grant to a nonprofit telecommunications entity to carry out a telecommunications-based demonstration project to improve the teaching of mathematics $2 25 million was appropriated for FY 1995

Leveraging Other Federal Programs. In addition to programs that directly address technology use in classrooms, the Office of Educational Technology is pursuing efforts to integrate effective technology usage into major education programs, including Title I of the Improving America's Schools Act These will ensure that federal dollars are supporting the most effective practices of integrating technology.

MILESTONES FOR SCHOOL TECHNOLOGY ACCESS

Since Vice President Gore's challenge to the telecommunications industry to provide linkages for the nation's classrooms by the year 2000, the Department, through its Office of Educational Technology, has begun to develop a set of milestones for schools' access to technology that include the Vice President's challenge and go beyond it to address other

important aspects of technology for learning. These milestones are based on goals that states, districts, and communities across the country have developed for themselves and recommendations released by hundreds of education, training, and business organizations.

They also reflect the goals expressed by the U.S Advisory Council on the National Information Infrastructure in its report, "Common Ground: Fundamental Principles for the National Information Infrastructure." After extensive review and comment, these milestones will be published in final form as part of a national plan released later this year In future years, the Department will measure its success against these milestones

By the year 2000 --

- All classrooms, libraries, and community-centered organizations will have connections to the National Information Infrastructure

- All Americans will acquire the knowledge and skills necessary to use computing and telecommunications technologies in support of education and life-long learning

- All schools will use technology effectively in support of the achievement of state and local content and performance standards.

- All teachers will have the knowledge and skills necessary to use technology successfully in their classrooms

CONCLUSION

The integration of technology into schools is a means of providing access to greater opportunities for all Americans, and especially our young people If we are successful, our young people will not only be better educated, but they will be better able to live and work in an increasingly information-oriented society The nation's schools have begun to invest in technology, but the road ahead is difficult and full of risks I believe that the Department can provide meaningful support and assistance to educators in this process, and thereby increase the chances that technology will fulfill its promise of opening up new opportunities for our citizens.

FUNDING FOR EDUCATIONAL TECHNOLOGY
($000'S)

Program	1995 Appro.	1996 Request
Educational Technology (ESEA III)		
Technology for Education (Part A)		
K-12 Technology Learning Challenge	$27,000	$50,000
Adult Learning Challenge	0	20,000
National Activities:		
Regional Technical Support and Professional Development	10,000	10,000
Federal Leadership	3,000	3,000
Subtotal	40,000	83,000
Star Schools (Part B)	30,000	30,000
Ready-to-Learn Television (Part C)	7,000	7,000
Telecommunications Demonstration Project for Mathematics (Part D)	2,250	2,250
Total	79,250	122,250

OFFICE OF EDUCATION TECHNOLOGY

Senator COCHRAN. Madame Secretary, let me ask you a question. I hate to interrupt you, but we passed the Goals 2000 Act, and in that legislation, authorized the establishment of an Office of Education Technology.

Could you tell us whether that Office is up and running, and what it is doing? Is it providing leadership in this area?

Ms. KUNIN. I think it is doing precisely what you intended, but doing so without a heavy bureaucracy, and doing so by being the convener and creating a focal point for education technology.

As you know, Linda Roberts is the head of that Office. The demand for her services and our services has just been tremendous. But we also do not have to do it all ourselves. We really are, in a sense, a catalyst and a connector between other groups that also have information.

Senator COCHRAN. I wonder if she could tell us, or maybe you can, how the office is interacting with State education boards, or others with whom they have contact, and how they are working to help provide leadership.

What are the details of that?

Ms. KUNIN. I will turn that over to Linda. Just let me emphasize one thing I did mention earlier. Probably the most effective tool for interaction has been Goals 2000, and the fact that States have produced technology plans as part of their Goals 2000 application process.

That has been the vehicle that has connected us formally. And then there are many, many informal connections with the private sector. We have become a kind of mecca for information, where information goes back out.

Linda, you probably would like to elaborate on that.

Dr. ROBERTS. Well, I know our time is very short, but very briefly, the single most important interaction that we have had has literally been with the State technology planning teams and the State Goals 2000 task forces.

Most of our interaction took place during the two conferences that we held here in Washington, where we had extensive opportunities to meet, to discuss not only on an individual State-by-State basis, Senator Cochran, but also bring the States together on a regional basis.

But in addition to that, I have made myself available to a number of the State planning teams across the country. I just came back from a trip to Alaska, where I met with not only the technology planning team, but also the members of the State board, the Lieutenant Governor, and the new commissioner of education.

And the role that we play is to validate, really to validate their efforts, to link them with resources that are available in their own States, and to help them negotiate the future of technology in their States.

NATIONAL LONG-RANGE TECHNOLOGY PLAN

Senator COCHRAN. I know that one of the efforts will be to develop a long-range plan, and I am curious to know what you see

now as the components of the plan, and when that will be completed.

Dr. ROBERTS. The plan is on schedule. We expect the plan to be ready for the Congress in September, as the legislation requires. We have conducted a number of meetings with experts in critical areas of, for example, financing and infrastructure of technology.

That is the single most important area we hear about from every State and every school district around the country. We have spent a great deal of time understanding the needs of teachers, both teachers in the system now and teachers coming into the system, so there is a focus on professional development.

We have also spent considerable time with experts in the field, trying to understand how we can influence the development of software and new applications. And finally, there is the whole issue of access and equity, but it is clearly related to the financing and infrastructure issues.

In following the requirements in the legislation, we are spending a lot of time listening to the education community, and trying to figure out how we can provide a vision for the future. That is what they would like the Secretary to do, as well as provide a real blueprint for action.

I am very confident that we will have a plan that combines the best of what we know, and really propels us into a number of activities that we know can make a difference over the next 5 years.

READY TO LEARN TELEVISION

Senator COCHRAN. I notice in today's USA Today, there is an article about the Ready to Learn Program, and I understand the Department has been working cooperatively with the Corporation for Public Broadcasting on the Ready to Learn Program. I was going to ask Dr. Robinson to comment about that.

This article talks about how preschool shows are part of a master plan. It sounds very interesting. I do not know whether you have had an opportunity to see this.

I was just handed this as I was on my way to this hearing. I am going to ask that it be put in the record at this point, so we will know what I am talking about, or those who read the record, if anybody ever does, will know what we were talking about.

[The information follows:]

[From USA Today, Apr. 4, 1995]

PBS PRESCHOOL SHOWS ARE PART OF A MASTER LESSON PLAN

(By Alan Bash)

In Toledo, Ohio, public TV station WGTE isn't just beaming out 8 hours daily of shows like "Sesame Street" and "Barney." In the words of president Shirley Timonere, WGTE is also "teaching people what to do with the shows when they get them."

The station holds about 1,000 workshops a year for parents and child care providers, teaching them how to hammer home the lessons for kids learned on PBS. Each month, WGTE gives out about 4,000 free books to kids, mostly titles mentioned on the PBS show "Reading Rainbow."

Today, the Corporation for Public Broadcasting will award $37,500 to WGTE for its role in public TV's initiative for preschool viewers, PTV: Ready to Learn.

Ready to Learn, beyond station outreach, provides:

Up to nine hours of uninterrupted preschool fare, including old shows such as "Mister Rogers" and newer ones such as "Shining Time Station."

Brief pro-social messages between shows from new characters called P-Pals.

PBS and the Corporation for Public Broadcasting (which has chipped in $7 million) are touting Ready to Learn, unveiling a new study and awarding station grants for outreach work. That news comes as the U.S. Senate holds a hearing today on educational funding and continues to mull CPB cuts.

The CPB-commissioned study found that 4-year-olds who watched one or more of four PBS shows—"Barney," "Sesame Street," "Reading Rainbow," and "Mister Roger"—were more likely to show of "emerging literacy" than non-viewers. (Emerging literacy includes recognizing letters, counting to 20 and naming colors.) The benefits were even more pronounced among poor children.

The study also reports that 88 percent of preschoolers watched one of the four PBS shows and that kids from all economic backgrounds were equally likely to watch them.

CPB admits the study, which compiled data from a 1993 government survey, is not a controlled experiment. Further, the initial survey asked questions about the four TV shows, not about Ready to Learn (which wasn't around yet), but CPB is touting it as evidence of Ready to Learn's success.

"Scientifically, it's useless" in proving Ready to Learn's value, says Larry Jarvik of the Center for the Study of Popular Culture, a frequent PBS critic. Nonetheless, CPB believes in the program, announcing today $200,000 in grants to stations.

CORPORATION FOR PUBLIC BROADCASTING

Senator COCHRAN. Could you comment on that for us? Please tell us what that is about.

Dr. ROBINSON. I would like to comment on that. The opportunity to work with the Corporation for Public Broadcasting——

Senator COCHRAN. You might pull the mike over, so we can hear you. Pull it up real close.

Dr. ROBINSON. Great; is that better?

Senator COCHRAN. That is very good. Thank you.

Dr. ROBINSON. I have not had a chance to see that article, but I am pleased to report on our progress working in collaboration with the Corporation for Public Broadcasting to develop new programming for preschool and young learners to deal with the issue of readiness.

We know that no matter what the quality of the instructional program, if we have not thought in terms of the context and the total life of these students, they are not going to be fully able to take advantage of what schools have to offer.

We need to take advantage of all media, all opportunities to interact with families and other caregivers, other adult caregivers, to help support students' capability to take advantage of educational opportunities.

I think in using this rather modest amount of funding, by working in a collaborative effort with the Corporation for Public Broadcasting, we are, in fact, leveraging other important resources to produce a more powerful outcome than would be possible if we were to work in isolation.

So I think it is a grand moment, where we can share what we know about learning, they can share what they know about the program development and the maximum potential of the medium, and we can provide a public service, as the Congress intended.

COST-EFFECTIVENESS OF TECHNOLOGY

Senator COCHRAN. Let me ask Secretary Kunin whether, based on the experience we have now and looking at the cost of these pro-

grams, are these new technologies providing cost-effective ways to enhance learning?

Ms. KUNIN. I do not know if we have a scientific answer that analyzes every program for its cost-effectiveness, but we do have enough evidence to tell us that, yes, by and large, they are working, and they reach students in classrooms that otherwise would not be reached with this level of educational, both excitement and subject matter.

So I think this is the way to go, for two reasons. One is, students have to be conversant and adept at using technology in order to be employed in the future, and two, technology is proving to be a very powerful educational tool.

But we do have to learn more about that. I do not think the full story is known yet. A very interesting and, I think, excellent report put out by the Office of Technology Assessment that you and your colleagues commissioned points out that one of the areas that we really have to emphasize is teachers and technology and making that connection.

What it also points out, though, is that we are moving in the right direction. We are moving in the right direction in giving teachers the kinds of skills and the kinds of information they need to make good decisions, to be cost-effective in their communities.

One of the hard questions is: How do you choose which software? How do you choose which kind of training program you should employ?

And these new consortia will enable many, many teachers to really have consultants that they can call upon, who know the latest information.

Senator COCHRAN. Dr. Robinson, do you have any comments along that line?

Dr. ROBINSON. Yes, Senator; I think it is important to say that as we change our definition of what we want schools to do, from simply conveying facts, to helping students be able to access facts and solve their own problems, technology moves from being an interesting tool, if it is possible, to becoming absolutely essential, because now we are requiring students to form their own questions, and our job is to support their pursuit of the answers.

There is no way for teachers to bring the resources necessary to support that kind of learning into every classroom without technology. It is almost beyond the cost-effectiveness issue, although that is a very important factor.

The question becomes how to bring the most powerful tool for accessing a wide range of data sources and information sources to every student, so that every student can pursue their highest learning aspirations.

Senator COCHRAN. Thank you very much.

Let me thank all of you for starting off this hearing in such a good fashion, giving us this overview, and the Department of Education's Federal role in this effort. Thank you very much.

Ms. KUNIN. Let me thank you, Senator, and your committee for your strong interest and strong support for this kind of change and involvement. We appreciate it very much.

Senator COCHRAN. Thank you.

NONDEPARTMENTAL WITNESSES

STATEMENT OF TOM BURNHAM, SUPERINTENDENT OF EDUCATION, STATE OF MISSISSIPPI, JACKSON, MS

Senator COCHRAN. Our next witness is Dr. Tom Burnham, who is the Superintendent of Education for the State of Mississippi.

I have to also notice for the record that my good friend, Charles Deeton is here. He has been a very fine leader in our State in education efforts, a member of the State board of education, always there when someone with good common sense and judgment is needed to help shape the policies in our State. We appreciate Charles being here.

Dr. Burnham, welcome. We have your statement, and as you know, we are trying to limit everybody to 5 minutes on their statement, to give us a chance to have a discussion of the issues.

You may proceed.

Dr. BURNHAM. Thank you very much, Senator Cochran. The State board of education and I thank you for this opportunity to appear before this committee.

I speak today as the chief State school officer who has had the privilege of serving 27 years in public education in my home State of Mississippi.

I truly appreciate the opportunity to share with you our State's commitment to education, and the vital role that the Federal Government has played and should continue to play in supporting and improving teaching and learning.

Mississippi is unique among the 50 States. The State's per capita income places us near the bottom of any list that you would choose to review. We spend approximately $3,500 per year per child on education, compared with the national average of $5,900 a year.

However, this expenditure represents 45 percent of our total State budget, and we are very proud of the fact that 73 percent of every education dollar in the State of Mississippi goes directly to the classroom.

Technology plays an important role in fostering systemic change and improving teaching and learning for all Mississippi children.

I want to talk to you today about several important technology initiatives that clearly demonstrate the valuable role of Federal support in education. These projects span all grade levels, but are joined by one common thread.

They were initiated or have been strengthened through Federal support. Mississippi is providing national leadership in two important technology initiatives, technical preparation and work place learning.

The initial funding for tech prep in the State of Mississippi was a Federal funding level of $1.4 million. It became a catalyst that set in motion the tech prep initiative in our State. To date, our

(17)

State legislature has appropriated $45 million to carry this initiative forward.

Students in the Mississippi Delta who have never been exposed to any career other than chopping weeds out of a cotton field, today explore worldwide technology careers that range from agri-science, to aerospace, and to a host of other activities that they never would have been exposed to otherwise.

Also, they are involved in the use of robotics and lasers and real-world applications. We are seeing concrete examples of improvement.

Average attendance in tech prep schools in Mississippi have soared to 96.4 percent per day, and the graduation rate is improving significantly. A parallel companion of tech prep is the Mississippi Educational Technology Enhancement Act of 1994.

This was brought forward by the success of tech prep and Federal funding for technology in Mississippi, and to date, our legislature has appropriated almost $100 million of matching money to continue these initiatives.

Another key program in our State is FiberNet 2000. This is a result of a partnership among 12 public-private entities, including four local school districts.

The FiberNet network delivers two-way audio and video instruction at the secondary and post-secondary level. FiberNet is being expanded in Mississippi this year thanks to a $927,000 State appropriation and a matching Federal grant of $560,000.

Through this program, teachers in electronic classrooms can see, hear, and personally interact with students in classes from German, to creative writing, to fine arts. Mississippi was one of the three original Star grant States in this Nation.

Today, more than 280 public schools in Mississippi and 3,000 students enjoy distance learning, ranging from Japanese, probability and statistics, advanced placement physics, history courses, and other examples of bringing higher-level academic courses into our classrooms.

In my State, we have explored technology as a means to make up for our inability to attract and retain highly qualified teachers in some instructional areas and in isolated rural communities.

Teacher shortages are high in Mississippi, as in most States. To date, we have issued over 964 emergency certificates, and the State board of education has identified a number of critical shortage areas.

The availability of these advanced courses opens up opportunities for previously denied students in rural Mississippi. Young Mississippians are acquiring credits in higher-level academic courses that otherwise would not be available to them.

For example, a young lady named Angel Bass in a small rural community, Senator Cochran, of Puckett, MS, needed a higher-level math course to be accepted to the Air Force Academy.

Her school did not offer this course. Through the Star Schools network and the SERC network, she was provided calculus. She was admitted to the Air Force Academy, and is now in attendance at the Air Force Academy.

This is an example of Federal dollars making a difference to young people who otherwise would not have these opportunities in rural Mississippi.

The integration of technology has educational benefits for our State, it is cost-effective, and it is necessary. Educational technology programs such as the Star Schools and the FiberNet 2000 Program have been instrumental in enabling the State to improve the educational outcomes and opportunities for students.

The number of courses that the high schools are offering have been increased. We are offering higher-level math, science, and foreign language courses that would not otherwise be available.

Seeking to determine the appropriate Federal role in funding educational technology is not an easy task, but I would propose to you today, it is based on three simple facts.

First, such funding should be a motivator. It should provide seed money to raise matching money for creative and innovative programs.

Second, it should help to equalize opportunity for all students, and provide minimum standards and national policies that free State and local educators and community leaders to do what is appropriate.

And third, it sustains successful initiatives that meet a broad-based need for all of our students.

A new paradigm is unfolding in our country. We must recognize that young people can no longer compete in a world market based on the strength of their back. The real key to success in the future of education is the use of technology.

Our vision of the future is one in which our young people are products of a system of educational excellence in which technology has played a vital role, and the Federal Government's involvement has been present without interruption.

PREPARED STATEMENT

It is vital to understand that our schools belong not to a single community, nor to a single State, but they are the Nation's schools, and what they are and what they become is a mirror image of the Nation's priorities.

Senator Cochran, I appreciate this opportunity to be here and provide this testimony and written record on behalf of educational technology.

[The statement follows:]

STATEMENT OF TOM BURNHAM

The Mississippi Lay Board of Education and I wish to thank you for this opportunity to appear before the Senate Appropriations Subcommittee on Labor, Health and Human Services, Education and Related Agencies.

I speak to you today as an educator who has had the privilege of serving twenty seven years in public education and currently serve as the chief state school officer for the state of Mississippi. I appreciate the opportunity to share with you our state's commitment to education and the vital role the federal government has played and should continue to play in supporting efforts to improve teaching and learning. In today's economic and political climate, with ever increasing demands and assurances of accountability, I hope my testimony today provides you with information that will assist you in making informed, responsible decisions which will impact not only Mississippi's children but also the nation's children.

Mississippi is unique among the 50 states. Harold Hodgkinson, in the 1993 SouthEastern Regional Vision for Education (SERVE) publication, *Southern Crossroads: A Demographic Look at the Southeast*, reported the following statistics based upon the 1990 census. Between 1980 and 1990, the state's population grew 2.1 percent compared to 9.8 percent for the nation. Much of the population is rural thereby exacerbating the cost of all educational, social, and health services. The population is the sixth youngest in the nation with 29 percent under the age of 18. Mississippi has the highest percentage of Black citizens in the nation with other ethnic groups comprising only a small percentage. The total minority population is 37 percent; however, minority youth comprise 46.7 percent of all youth. Mississippi has a high level of adult illiteracy, and a history of high unemployment. We have 153 school districts, 78 of these districts have fewer than 3,000 students, 117 of these have fewer than 4,000 students. Over 60% of the schools enroll fewer than 1,000 students.

These factors seem to be enormous barriers; however. Mississippi has made tremendous advances. In 1993, it led the Southeast in personal income growth, was one of only three states which showed an actual decrease in welfare payments and was ranked first for its economic recovery by US News and World Report. In its annual Manufacturing States Comparative Report for both 1992 and 1994, Whirlpool Corporation rated Mississippi's business climate first among the 23 states where major home appliances are produced. Substantial increases in the latest figures for housing starts, total employment, manufacturing employment and nonagricultural

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employment of Mississippi residents are good indicators of a viable economic climate for young Mississippians--if we can ensure that they are educated to enter the work force with skills that will make them employable. Our emphasis on performance, the increased accreditation standards. the technology initiatives--all have played vital roles in increased test scores in math and language over a seven-year period, with students in grades 4, 6 and 8 performing in these areas at or near the 50th percentile. In 1994. NCE scores for these students were above the 50th percentile in math and language. with only reading scores significantly below the national average. Mississippi students in grades 4 and 6 have made consistent gains in reading scores on the Stanford Achievement Test since 1988.

Because the state's per capita income places us at or near the bottom of any list of monetary resources, we spend $3,512 per pupil on education per year, compared with the national average of $5,901 per student as reported by the National Center for Educational Statistics. However, this represents 45% of our total state budget . We are proud of the fact that 73% of education dollars go straight to the classroom. A snapshot of a Mississippi school district's funding will show the following: 54% from state resources: 30% from local resources and 16% from federal resources.

Technology plays an important role in fostering systemic change and improving teaching and learning for all Mississippi's children. Current projects span all grade levels and are. in each case. the result of collaboration between and among communities, schools, multi-state consortia. and state and federal agencies. These initiatives are joined by one common thread they **were initiated or have been strengthened through federal support.**

In ensuring that we create a school-to-work system in which students become active participants and contributors to our democracy. Mississippi is providing national leadership in two important technology initiatives: (a) technical preparation (b) work-based learning. Senators Cochran and Pell sponsored the legislation that established Tech Prep within Title III of the Perkins Act. This landmark act set aside dollars for the integration of academic and vocational curricula. Hearing were held in 5 locations in Mississippi to begin the program. The federal funding of $1.4-million was the catalyst that set in motion a state initiative which has provided to date $37.4-million in state monies. The state legislature just appropriated another $7.6 million for 1996 for the Tech Prep project. The total projected state investment will be $105 million over 5 years. Tech Prep is a total cooperative and connected community effort, with

businesses, parents, students, secondary schools, and community/junior colleges involved in the preparation for a lifetime of learning that will meet employer demands and allow career advancement. The technologically appropriate sequence of courses related to an individual's career is a far-sighted and far-reaching instructional program that would not be possible without federal involvement in educational technology. It is a sequence of study beginning in the middle school and continuing through post-secondary education.

Tech Prep was begun as a pilot program resulting from a five-year plan to move our schools into a technology-based curriculum which will prepare our children for the 21st century. During the 1993-94 school year, 15 pilot sites focused on implementing (a) contextual methodology in English I, pre-algebra and Biology I courses, (b) academic vocational integration teacher teams, (c) career centers, (d) secondary and post-secondary articulation plans and (e) a national assessment of academic gain. In addition, students participate in a Career Discovery course for all seventh graders; a Computer Discovery course for all eighth graders; and a Technology Discovery course for all ninth graders. These courses consist of hands-on laboratory learning experiences. Every student is required to take the courses in Mississippi schools where they are offered. These technology courses are more sophisticated and job-oriented than any previous courses available to Mississippi students, dictating a practical application of education in today's world. Through high school career labs and the Career Discovery course, students in the Missisisppi Delta who have never been exposed to any careers other than chopping weeds out of a cotton field explore worldwide career opportunities that range from agriscience to aerospace and marine biology. The Technology Discovery curriculum includes lasers, robotics and biomedical applications and focuses on activities that have real-life applications. Examples include building bridges from balsawood and performing stress tests on them. Tech Prep provides an avenue to successful employment, with multiple exit points (to work, to an associate degree, or to further advanced education). In the final analysis the most important point is that every student engages in higher level math, science, and technology coursework and exits high school better prepared for post-secondary education or the workforce.

It is clear that federal funding related to Tech Prep has been the impetus for schools to move into a more structured curriculum as a direct result of federal involvement and to raise the standards for school accreditation throughout the state.

The funds are used for career centers, applied teaching methods, and the integration and articulation of the curriculum. We are now in the second year of funding, and 66 sites are operating. In 1996, 51 more districts will implement Tech Prep, involving over 300 sites To date, over 50,000 Mississippi students have been engaged in this initiative

Although the percentage of federal funding has been relatively small in comparison with state funding, federal support is important because of the leadership supporting the infrastructure and delivery system. Funds also train coordinators, and establish consortia with the impetus for coordination of secondary and post-secondary education and paralleling college preparatory curricula. Loss of these federal Tech Prep funding would remove all 15 Tech Prep coordinators at Mississippi's community colleges These coordinators are critical because they ensure the articulation between secondary and post-secondary curriculum which is a key component in providing a successful transition for students   The high point of the initiative is that average attendance since the inauguration of Tech Prep has soared to 96.4%, and the graduation rate has also improved significantly.

A parallel component of Tech Prep is the Mississippi Education Technology Enhancement Act of 1994. Encouraged by the successes of Tech Prep. the Mississippi legislature sought to provide funds for technology-barren K-12 Mississippi classrooms. This landmark technology legislation provides for the development and implementation of a state technology plan and subsequent district technology plans to 'improve teaching and learning and the ability to meet individual students' needs. to improve curriculum delivery to help meet the needs for educational equity across the state " It closely parallels and complements the Goals 2000: Educate America Act and strongly affirms a commitment to providing all students access to adequate resources and opportunities through strong local involvement. The Technology Enhancement Act set aside classroom technology funds in the amount of almost $100 million, $38 million in state cash investment and $60 million in state bonds, to fill in the gaps between federal technology funds, local sources and state Tech Prep initiatives. Funds will be distributed to local districts beginning in January, 1996.

The bill also created a Council for Educational Technology that is representative of all stakeholders within Mississippi, such as teachers, administrators, business and industry leaders. parents. university and community college personnel and community members This Council is charged with the task of writing the state technology plan. An

important part of this process will be to provide vehicles to gather input from other stakeholders, such as elected officials, policy makers, parents, and community members. The variety of methods used will range from conducting regional public forums, to participation in online bulletin boards, to interactive statewide community meetings. The primary task of the Council is to develop a state technology plan that supports the systemic reform of elementary and secondary education. This historic piece of legislation also established the Office of Educational Technology within the Department of Education to support technology initiatives.

The relationship between the Technology Enhancement Act and the Goals 2000 initiative is a symbiotic one. In order to provide continuity and coordination between the State Improvement Plan and the Council for Educational Technology, at least one member of the Technology Council will serve on the Improvement Plan Panel. The Council will function as the technology task force required by the Goals 2000 legislation. These vital links will ensure that the technology plan fully supports Goals 2000 initiatives.

Another key program is FiberNet 2000, which is the result of a partnership among 12 public/private entities including four local school districts. The FiberNet network delivers two-way audio and video instruction at the secondary, college and graduate level. FiberNet 2000 is being expanded this year to twenty districts throughout the state thanks to a state appropriation of $927,000 and a matching NTIA (National Telecommunications and Information Agency) grant of $560,000. Through this program, teachers in interactive electronic classes can see, hear and personally interact with all their students in classes located at remote sites. Courses offered through FiberNet in 1994-1995 include German, advanced computer applications, college algebra, automated accounting, fine arts, broadcast journalism, business communications, and creative writing. After-school, evening, and weekend programming includes college level education courses such in professional nursing, emerging technologies, and gifted education courses. The increased demands for time and programming space on the network have come from FiberNet participants as well as from other groups, public and private, across Mississippi. Major corporations such as Dow Corning and others are referring numerous people to FiberNet personnel for information on the network.

Such activities are part of what today's educators are likely to call "distance learning. Enabling our students to participate in programs that draw them together in

educational settings that could not have been imagined only a short time ago. Mississippi was part of the original Star Schools grant, one of only three states to receive this opportunity for satellite classes available to rural districts. Not only did the state participate as a partner, but many other Star Schools grantees serviced schools within the state. That participation has continued. Today more than 280 public schools throughout Mississippi currently have downlinks to receive programming from distance learning providers such as TI-IN, Oklahoma State, Kansas State, and SERC(Satellite Regional Education Consortium) and over 3,000 students are served. High school in poor rural areas provide students with Japanese Courses from Nebraska, probability and statistics from Kentucky, advanced placement physics from Oklahoma, and history from Alabama. The mobile television unit acquired under the project has allowed Mississippi to develop programs and share them throughout the state. As a result of Star Schools and NTIA (the National Telecommunications and Information Agency) funding, additional downlinks are being installed. A $1-million grant from NTIA in 1992 allowed Mississippi ETV to replace old transmission equipment and to install satellite uplink services and produce its first live distance learning classes. I want to commend the committee for restoring the Star School funding.

In my state, we have explored technology as a means to make up for our inability to attract highly quarified teachers in some instructional areas and to reach comparatively isolated communities. Teacher shortages are high, especially in the Mississippi River Delta area. Last year, over 964 emergency certificates were issued. The State Board of Education has identified critical shortage areas of special education, mathematics, and foreign languages. In addition, the Board has identified 18 (out of the total of 82) counties in which critical shortages exist. To help recruit teachers and alleviate this problem, two scholarship programs have been set up and in July, 1994, the Mississippi Teacher Center was created. For many districts, the answer to this problem is distance learning through such programs as the Star Schools and Fibernet 2000.

The availability of these advanced courses opens up opportunities previously denied students in rural Mississippi. Young Mississippians can acquire credits in higher level academic classes that otherwise would not be available to them. For example, Angel Bass, a young student in Puckett, Mississippi, wanted to apply for admission to the Air Force Academy. In order to have a chance to be accepted, she needed to successfully complete an advanced mathematics course. Her high school

offered Calculus via the SERC distance learning programming. The course is taught by a teacher from a classroom in Corinth, Mississippi, in cooperation with Mississippi ETV, SERC, the State Department of Education and the Corinth School District. It is satisfying to note that the student successfully completed the calculus cou.se, applied to the Academy, was accepted, and is now in attendance.

Federal funds from Chapter 2, Eisenhower, and the National Diffusion Network are also used to match state funding and support technology goals within the state. Chapter 2 uses technology funds to coordinate programs for the development and use of technology in the classroom as well as coordinate with the Institutions of Higher Learning and Educational Television in the areas of using technology for learning and information sharing. An exemplary local initiative is the Global Awareness Project in the Long Beach School District, located on the Gulf Coast. This is a cooperative instructional effort to integrate science and social studies disciplines through technology-based instruction. Students determine effects of pollution runoff transmitted through precipitation, rainfall, and drainage in countries that border common waters of the Gulf of Mexico and/or Caribbean. The students analyze the environmental, social, and political similarities and differences of these countries. Students use the Internet to work in cooperative groups with fellow students in the Department of Defense schools in the Caribbean.

The Dwight D. Eisenhower project provides teachers and other appropriate individuals with training in computer, video and other telecommunications technologies as part of math and science programs. A focus is to promote increased use of technology by math and science teachers. Funding of the PsiNet project provides scientific technical assistance to district science teachers using a computer network link . A cooperative project funded by Eisenhower grants and the Woodrow Wilson Foundation established summer workshops for 40 teachers in the use of technology in math and science classrooms. Topics covered in the 1994-95 workshops include Telelearning: Creating Connections. Biotechnology and Technology Applications in Physics.

There are numerous other successful technology programs. The Mississippi Online Network is a data exchange computer system which connects all school districts in the state with the State Department of Education. It provides data base access, electronic fund transfer, and other administrative functions. The Writing to Read project, a cooperative effort of IBM, the state of Mississippi and the Riordan

Foundation, places Writing to Read computer labs in kindergarten and first grade elementary schools across the state. Project LEAP (an acronym for Learn, Earn, And Prosper), which utilizes the Star Schools equipment after school hours, was created in response to a federal literacy training mandate. The program teaches basic literacy and job skills to eligible Mississippians from 4:00 p.m. to 8:00 p.m.

The Tri-State Educational Initiative is a cooperative partnership among thirty school districts in Mississippi, Tennessee and Alabama. It is the only GOALS 2000 region in the nation encompassing three states and one of seven sites selected by the US Department of Education for Staff Development in Science. It has been recognized by the SouthEastern Regional Vision for Education (SERVE) as a "One-of-a-Kind" Program in the nation for excellence in education reform.

Creating more self-directed and self-motivated learners-- independent learners-- is a goal of such programs. While some of the evidence is admittedly anecdotal, there is other, more definitive and harder evidence that the integration of technology has educational benefits. is cost effective, and is necessary.

I spoke a moment ago about some schools in the Delta as examples of isolation and inequity. compared not only with other schools elsewhere in the nation but with other Mississippi schools as well. For a closer comparison, we can look at the educational opportunities in Jackson. Mississippi. only thirty miles south of the lower Delta. where five major telecommunications companies are located, librarians are in every school, and internet access is available. In some compelling ways. I believe that Mississippi is at the forefront of global technological change and economic development. Let me point to some facts that substantiate that belief.

In Mississippi, we are not talking about some remote place where our children do not need technological knowledge and training. You can see--from what I just reported--that the opportunities are there, the need is there, the potential for development is there---and our children are there. We must prepare them to be successful, contributing members of society. And in that preparation, we will make the state even more attractive as a site for future technological investment and corporate confidence that a trained wor'. force will be available.

I believe that economic competitiveness is dependent on technological competence to provide literate entry-level workers, and we must not stand still and simply maintain the status quo; if we did that, we would surely go backward. We have to strengthen our curricula, upgrade our skills. anticipate our needs, and establish

reasonable and sound priorities and goals. In a global economy, a skilled work force is key to attracting industry and economic development.

While Mississippi has problems with teacher shortages and funding, we have been successful at maintaining high expectations for our students. We are maximizing our resources in the most effective ways through our performance-based accreditation, which identifies and recognizes successful schools and frees them from state regulations, at the same time targeting financial and human resources to failing districts to help them become successful. Our performance-based accreditation standards have been substantially raised and our expectations of students are higher than they were only a short time ago. We are one of the few states in the nation that accredits our schools based upon performance. The system accredits school districts on a scale of 1-5, with Level 1 being Probationary and Level 5 being Exemplary. We then target resources to those Level 1 and 2 districts to focus on improvement. The State Board of Education has just approved revisions to the performance-based accreditation system which increases standards and incorporates an index to the accreditation levels that allows a community to determine if their schools are improving or declining within the accreditation level. We have also just released the Mississippi Report Card for 1994 which provides school level data, including test data, demographic data, and economic data for all districts in the state.

Educational technology programs such as the Star Schools and the FiberNet 2000 programs have been instrumental in enabling the state to improve its educational outcomes and opportunities. The number of courses that a high school must offer has increased from 26 to 32, and higher level math, science, and foreign language courses have been added to the curriculum of our most remote schools. Distance learning has also enabled Mississippi to raise its graduation requirements from 18 to 22, and require Algebra I and a lab-based science for graduation. This is a concrete, documented result of the use of technology and its positive effects.

Programs such as those envisioned in Title III of the Improving America's Schools Act will be the catalyst that enables Mississippi and other states to maximize the influence of telecommunications in learning and teaching. The parallel action in the Senate Commerce Committee will seriously influence the applications of learning technology. The revision of the Communications Act of 1934 will determine to a great degree how effectively education can use modern telecommunications. Schools and learners must be included in this Act by providing affordable education

telecommunications rates. Schools must be included in universal service. Schools should receive funding from the spectrum auctions to be used to develop demonstrations of high performance technology in each state. The role of the federal government in establishing national policies on learning technologies is critical in order for all learners in Mississippi to have 'access to the new information infrastructure.

Seeking to determine the appropriate federal role in funding educational technology, one is quickly faced with a number of compelling arguments, not the least of which is concerned with the total financial resources available to the government. I submit that the appropriate role must be based on these facts: first, such funding is a motivator, a provider of incentive, an impetus for later development, providing seed money to raise matching funds for creative and innovative programs that otherwise would never be tried; second, it helps to equalize opportunity, filling in the gaps and helping to prevent exclusion from opportunity for many students simply because they live in one location rather than another; it is the vehicle for inclusion of all our children--not simply those who are fortunate and privileged, ensuring that access to the information highway is not restricted only to those with money and resources; it provides for establishing minimum standards that free state and local educators and community leaders to do what is appropriate and necessary for the students in that location; and it sustains successful initiatives 'hat meet a broad-based need.

A new paradigm is unfolding in this country--we must recognize that we can no longer compete in a world market based on the strength of our back. The real key to the success and future of this nation is the use of technology. Our students must learn the new essential skills to become information navigators, critical thinkers and problem-solvers, effective communicators through the new tools available, and discriminating selectors of appropriate technology resources. We must restructure public education to meet the needs expressed in this new paradigm or we will suffer consequences that, I predict, would be a national disaster. We must not permit that to happen! Helping states and local school districts to harness the benefits of existing and emerging technology is a role appropriate to the federal government. Building tomorrow's work force is a national goal that can be met only with federal help to teach the future today, to help our young people look into a future filled with technology. When I was a high school student, the technologies available today such as electronic data interchanges, systems integration, optical imaging, desktop publishing,

networking, centralized data distribution operations, simulated sales management courses were only images from science fiction novels. **Our vision of the future is one in which our young people are products of a system of educational excellence in which technology has played a vital role and the federal involvement has been present without interruption.**

Our children deserve the best education we can provide, and as a nation we must continue to provide the leadership that has made the United States a country where opportunities were limited only by one's imaginations. We must focus our committment on providing incentives to states and local communities to use their resources, no matter how limited, efficiently and effectively. Too often, for some school districts what is left is not enough even to open the door to the world of technology, much less to make costly initial investments in training and equipment and supplies and sustain the effort in light of increasingly rapid technological advances.

As a summation directed to the heart of my testimony, please permit me to make some general comments about American schools based on my knowledge of Mississippi schools in particular These thoughts are the foundation for all that I have said--and they are appropriate as a basis for examining federal support for educational technology.

I know that the effectiveness of American public education is being sincerely questioned by a great many people today, and I am aware of some of the causes for their concerns. But I take a far different view. It has always seemed to me that the American public school is one of the great success stories of our history. No other institution, I think, could have taken the vastly diverse elements that have contributed to our nation and helped to provide an American identity, at the same time respecting and celebrating the differences that mark us as individuals. Those who compare us with other countries ignore the fact that we educate all of our children. The American schools have welcomed all the children of our communities--together with the adults who needed help--educated them, given them the necessary skills and knowledge, protected them, cared for them, filled them with hope, and made them successful builders and shapers of the national life. America remains a land of unlimited opportunity and potential.

And having done all this, the schools today have unfortunately--and I think unfairly--become in some measure a whipping boy for the very society they have served so well. Too often schools are blamed for the nation's ills--when the truth is

that the schools have been and continue to be the single greatest force in correcting society's problems and shouldering the tasks no one else and no other force can handle. And because we have done our job so well, if we tried to write a job description for ourselves today, it would have to include educator, advisor, disciplinarian, counselor, social worker, nutrition expert, drug specialist, technology consultant, nurse, surrogate parent, creative nurturer, media expert, perpetual student, role model, financial analyst and--in today's world--amateur lawyer. Far too many of the institutions and individuals who in the past took some responsibility for giving young people guidance and assistance no longer do so--or do so only in very limited ways. Too many parents have abdicated their responsibilities; churches no longer have as active a role in the nurturing of a whole community's young people; governmental agencies have become too involved in bureaucratic hair-splitting to be even remotely helpful. And as a result, when American society is faced with a problem today, very often the first suggestion for moving toward a solution is to look to the schools, no matter whether we have the equipment or the money or time or expertise to deal with the problem.

Having said all this, however, I must add that I do not share a widely held view that schools are in deterioration and decline; that we're doomed to mediocrity at best or utter failure at worst. I refuse to accept the widespread belief that we're just going from bad to worse. I remain optimistic because I spend time with teachers and students and have a better perspective, I think, than that of critics who might well be advised to immerse themselves in the total process of education rather than standing on the sidelines. I believe in our schools, our mission and our successes; and I think it highly unlikely that any other institution could have dealt with the scope of problems our schools have faced and remained so viable and highly respected.

It is vital to understand that our schools belong not to a single community nor to a single state. They are the nation's schools. What they are--what they will become--is not only a reflection of what a city or a state does, but also of what the national interest requires--a mirror image of what the nation wants and needs and of the measure of support the nation as a whole has provided. For now and forever we must recognize . that we cannot afford to isolate and simply write off any American schools anywhere; we must be united in our effort to make them reflect only the very best part of ourselves.

It is my hope that this subcommittee will affirm the necessity and the fundamental rightness and soundness of providing continuing federal funding for educational technology in the nation's schools. And I also hope that my testimony has given you some sense of my conviction that this funding is appropriate, cost-effective, and beneficial in countless ways to all our children. The American people expect Congress to manage the budget in a responsible manner, to cut excess, to trim fat, and remove waste; however, they never intended and will probably not support indiscriminant slashing of effective programs.

Thank you for giving me this opportunity to address the subcommittee. I am grateful for having had the chance to speak for the children of Mississippi and, indeed, of the country and also to speak for the educators who are in positions of leadership and who must make decisions that will guide our children into the next century.

MAGNET SCHOOLS PROGRAM

Senator COCHRAN. Thank you very much, Dr. Burnham, for your excellent statement, and for your leadership in our State and throughout the country in education matters.

I am really pleased that your testimony indicates that State legislatures, and our State government, and private sources, too, are providing funds to help make available these new technologies in our classrooms in Mississippi.

I know that one other example that came to my attention, because of a visit by my legislative assistant, Doris Dixon to the Le Flore County area in Mississippi, was to learn about the magnet schools program, where funds are available for grant applicants.

And in that case, the Hayes-Cooper Elementary School applied for and got a grant, and used it to buy computers for the classroom.

In this elementary school, which is no different from any other elementary schools throughout our State, the experience was that students came to school every day. They came early; they stayed late.

Teachers began being more dedicated to their jobs, as a result of these new computers in the classrooms. They had computers for almost all the children.

The fact is, too, test scores started skyrocketing. Everybody started making better grades. The entire complexion of the school changed, and the community along with it. Parents got interested and excited, and started checking to see what was going on at the school that made the children so happy. It was quite an unbelievable story.

Are you familiar with that? Are there other stories like that around our State?

Dr. BURNHAM. Yes, sir; there are companion stories all over the State of Mississippi. Technology is making a difference in our State today, Senator Cochran.

We recognize that technology will never replace quality teaching, technology is a resource, but we are seeing many school districts

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who are exciting young people about learning, who are now becoming interested in careers they never would have been exposed to, had it not been for technology.

Senator COCHRAN. One of the things that you talk about is the fact that the Federal money should be seed money, and that should stimulate the flow of funds from other sources, like the States and private resources. I know that our State legislature, according to your testimony, has appropriated $100 million for this activity.

How much money have you seen come into these programs from private sources? Have others been as generous or as willing to participate?

Dr. BURNHAM. We have had excellent support from, particularly, public bodies in the States, such as the telephone companies, the power companies, others who have made funds available as matching dollars, and also a number of foundations who have contributed to technology in our State.

But it is important to recognize, and I return to the point, that the initial catalyst was the Federal dollars that came into the State.

Senator COCHRAN. I know that our State received a grant, a technology planning grant, under the Goals 2000 Act. I know that required putting together a grant application and bringing in people from different levels of government, and maybe private sources, too.

Could you tell us about how that worked, and what effect that had on the attitude toward public education in Mississippi?

Dr. BURNHAM. It is building a lot of enthusiasm for public education. As you indicated, it was a planning grant. We have utilized that planning grant to convene focus groups, to convene input groups throughout the State.

They are sharing with the individuals who are putting together the actual plan for the State, their vision of technology, how it should be incorporated into the classrooms.

Senator COCHRAN. Well, I really appreciate your being here to give us these firsthand experiences of yours as State superintendent, and the experiences that we have had in our State, taking advantage of some of these grant programs, and the effect that they have had on children and the classroom teaching experience of our teachers.

And we thank you most of all for your strong leadership for public education.

Dr. BURNHAM. Thank you, Senator Cochran. I would be remiss if I did not thank you for your initial efforts on tech prep, because tech prep is making a difference in our State, and we thank you for that.

Senator COCHRAN. Thank you, Tom.

STATEMENT OF GARY VANCE, EXECUTIVE DIRECTOR, SATELLITE EDUCATIONAL RESOURCES CONSORTIUM, COLUMBIA, SC

Senator COCHRAN. It is my pleasure to invite our next panel to come to the witness table. We have Mr. Gary Vance, who is executive director of the Satellite Educational Resources Consortium, from Columbia, SC; Mr. Walt Hindenlang, president, and Mr. Ben Casados, executive director of Hughes Electronics Galaxy Institute

for Education, from El Segundo, CA; Dr. Carolyn Reid-Wallace, who is senior vice president, Education Corporation for Public Broadcasting; Ms. Joy Rouse, president of the board of education in St. Louis County, MO; Ms. Joan Miller, math teacher from West Sylvan Middle School, in Portland, OR; and Ms. Beryl Jackson, PBS Mathline, from Alexandria.

I welcome all of you. I think I called out more names than we have people at the witness table. So we will have to call the roll here in a minute.

Let me first invite Mr. Vance to begin our panel discussion, again, reminding those who are participating in the panel of the 5-minute rule that we have. We hope you can limit your statements to 5 minutes each, and we will then have an opportunity to discuss the issues.

Mr. Vance, you may begin.

Mr. VANCE. Thank you, Senator Cochran.

I did see the Academy Awards last week, as I think everyone else did, and everyone was prompted to hurry up. So I will try to do that myself. It is fresh in my mind.

I especially appreciate the opportunity to follow Dr. Burnham with my remarks, and I appreciate the things that he said about the impact that SERC and other organizations like that have had in the State of Mississippi.

I do not think you could have had a better explanation of the impact that distance learning and other kinds of technology-based resources can have upon all our States, and especially rural States like Mississippi. So I appreciate that opportunity.

For the record, my name is Gary Vance. I am the executive director of the Satellite Educational Resources Consortium [SERC], as it is more commonly known.

As you know, Senator, SERC was the recipient of two 2-year Star Schools awards during the first- and the third-year funding cycles of that program.

We are currently operating without any direct Federal funding and support. And it would be important to note, I think, that our States, our members, and our schools have bought into the seeds that were planted by the Federal investment.

We are able to continue. We are viable. We are moving forward with our mission through the membership support and the tuitions that are paid by the schools that take advantage of our courses. I think that is an important point to note.

It also might be interesting to note that SERC is a partnership between our member State departments of public construction, represented by people like Dr. Burnham, and their technology counterparts, the public television agencies of our member States.

That partnership that we began with and that we continued with is critical to what we have been able to do, and will be even more critical to the development of our future work.

And I think that was alluded to in the first panel, when you heard from the Department of Education, and the partnerships that have to be created through Federal Government, the State organizations, and local schools.

SERC's mission is to strengthen existing resources in the K through 12 educational community, and also to provide resources that would not otherwise be available.

We do this through this partnership, and through a technology infrastructure that uses satellite, broadcast television, telephone, a keypad response system, and most recently, computer-based e-mail within our schools.

After 6½ years of operation, we have a particular perspective, I think, that reflects our successes, our failures, our direction, and our needs.

And I believe that this perspective would be shared by most, if not all of our colleagues in the K through 12 distance-learning arena, many of my colleagues that have been under the Star Schools Program and are currently operating under Star Schools.

I would like to highlight just a few observations, based on that perspective, and I hope that we can address some of them in more depth during the question period.

First of all, to the question, is there a continued and appropriate Federal role in the development of distance-learning resources, the answer, as you would probably not be surprised to hear from us is, certainly, yes.

But I would like to give just a slightly different perspective from what you may have heard from some of the others.

We believe that the greatest promise of distance learning, one that we are still reaching for, is its ability to cross the economic, the cultural, and the geographic barriers that we all live within in this country.

This promise cannot be achieved through a piecemeal approach to developing technology-based educational resources. Local projects, based in schools, are very important. State initiatives have to reflect the needs and the priorities that have been identified in those States.

But as we move rapidly toward a more global economy, based on information management, which is what I think we are talking about, a local and even a State perspective is not enough.

So if there is one thought I would leave you with regarding the Federal role, it would be that the Federal Government must create or cause to be created the linkages between the learning resources, the ideas, experiences, and people. You have heard testimony to that already.

The Federal Government must be the catalyst to propel us across the cultural, the geographic, and the economic barriers that exist.

In my written testimony, I have addressed several points regarding the Federal funding of distance learning, and I would like to highlight again just a couple of those to stimulate further discussion.

First of all, I would suggest that the grant cycles need to be longer. Current legislation that you have passed addresses this, but please do not stop; 2 years is barely enough time to get a project launched.

It is far short of the time needed to conduct formative evaluation and longitudinal studies critical to future decisionmaking, and it is too short a time, and I think this is important, to infuse a new

learning structure and organizational infrastructure in a traditional bound education system.

And second, please create legislation that considers two needs, the need to explore, through demonstration, what is new and exciting, but equally as important, that provides funds for the refinement of the resources and infrastructures that exist.

Technological advances are occurring too quickly to allow a social structure like education to react in any meaningful way, to the latest, the fastest, or the most powerful.

At the same time, these same technological advances are too important to ignore, so what is needed is legislation that supports both, a demonstration of the new and a refinement of the established, things that will have lasting value in the schools.

Our march to a technology infrastructure that is overlaid onto our existing structures will happen as an evolution, and not an explosion.

Mr. Chairman, I have not talked much about SERC. I do not think that is the role I was asked to play here today. I would love to talk about numbers and our success, but if you would like to hear about it, I would be glad to talk about it later.

PREPARED STATEMENT

My written testimony does cover many of these points I have raised in detail, but I look forward to hearing from the other panelists and participating in the discussion.

I thank you for the opportunity.

Senator COCHRAN. Thank you, Mr. Vance. Your entire statement will be a part of the record. We appreciate having all of that information that you have provided to the committee.

[The statement follows:]

STATEMENT OF GARY VANCE

My name is Gary Vance, and I am Executive Director of the Satellite Educational Resources Consortium, or SERC, as it is more commonly known. SERC is one of several major providers of distance learning resources to students and professional educators in both high schools and middle schools across the nation. I represent an organization that fits a particular niche in the scheme of federal funding for distance learning. While SERC has been a federal grant participant, the organization no longer receives direct federal support. I am pleased to report that your funds have been well spent, and that the mission we undertook seven short years ago remains vital to the educational welfare of this nation.

Background

I want to begin my remarks with a brief history. While I will focus on SERC, I think much of our experience is similar to other Star Schools projects. We have all created instructional models that use technology to link, to inform and to connect the learner to a part of the world they would not otherwise experience. We all focus on populations that for whatever reason, do not have equitable access to vital resources. We all strive to create the highest quality in terms of instructional design, high interest, and relevance to our nation's educational needs.

Beyond those broad similarities among Star Schools projects, however, there are differences. There are differences in the ways we use technology, differences in the learner populations we serve, and differences in the structures from which we operate to make our classes, our enrichment offerings and our staff development happen.

It is in the last area, structure, that SERC can proudly claim a uniqueness that led to its early success and its ability to remain vital, even without federal funding. SERC is a partnership between public television and state departments of education. Through its education partners, SERC plays a unique role in determining direction for change in school reform, curricular needs and regulatory issues. Through its public television partners, SERC benefits from a powerful technology infrastructure. This includes the production capability and expertise of public television stations and networks from the east coast to the northern plains. The infrastructure includes on-site technical support which public television gives to schools using satellite and digital compression technology. It includes access to state-of-the-art satellite technology, also funded by Congress. It also gives SERC the opportunity to leverage opportunities already existing in member states. Perhaps the best example of this is in the case of Kentucky, where KET operates Star

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Channels, a state-wide distance learning infrastructure that can reach into every high school. Through the SERC partnership, those same state resources are available to students throughout the consortium

In this time when both educational institutions and public television are under such scrutiny, it is important to recognize that without this state-by-state structure, distance learning, both as it is defined now and as it will be defined, will suffer greatly. In the case of SERC, the organization would not be able to continue without the sustaining support of our partners who fund our collective endeavors from their own state, federal and user sources I cannot emphasize strongly enough my concern that in the quest for "new and different" we will risk the rich and powerful infrastructure that exists, particularly within public television We seek to connect users to appropriate resources We seek to create an infrastructure that offers universal access We seek to create resources that are cost effective In so many ways, Mr Chairman, public television already does that As you continue the deliberative process, please build on what you have, rather than rebuild with the unknown and unproved

SERC was one of the original four projects funded through the Star Schools program The consortium was not eligible for funding in the second round of grants, but was successful in the third round The strengths that led to those two awards remain at the core of SERC's mission and structure

SERC is a consortium of states We currently have twenty-one members and serve students and teachers in twenty-eight states These SERC partners together provide collectively what none of them could do individually because of costs and limited access to information and resources. The consortium members also share a vision of how the education process can be made more equitable and more effective through a three-way partnership between the learner, the local education community and the distance learning provider

The core mission was, and still remains, to provide technology-mediated, critically needed resources to high school students, and more recently, middle school students, who for whatever reason can not otherwise obtain those resources Each day students in twenty-eight states participate in credit courses in foreign language, mathematics, science and economics Twenty-six thousand SERC students have earned high school credit With the addition of middle school offerings, funded through our third round Star Schools grant, SERC has served over two hundred thousand students in grades six, seven and

eight. They and their teachers participate in a comprehensive integrated science program that strengthens and builds on the existing classroom curriculum

No less important is SERC's growing emphasis on professional development for educators While direct instruction to students is important when resources are not available, the far-reaching potential for connectivity between people, ideas, and information may be the greatest contribution of distance learning From its inception SERC has offered over seventy-nine multi-session professional development opportunities, eleven graduate courses and two major reform initiatives that served educators and community leaders in all fifty states These major projects used a combination of teleconferences and audio breakout sessions This format allows participants to interact with leaders in the educational reform movement and then work with peers in small but geographically diverse settings to bring local relevance to the principles and ideas being generated

Use of Federal Funds

Mr Chairman, you asked that I address the issue of how SERC used its federal funds to establish and expand its program At the outset let me say that SERC would not exist as it is today were it not for the support of the federal government I would be less than candid were I not to say that we are impeded by our current lack of access to these funds We can proudly say that we continue to offer nineteen courses and a strong slate of staff development What we lack is the ability to create new resources We also lack the ability to expand the base of users who still require the equipment needed to tap into the information infrastructure

During the two, two-year grant cycles in which SERC participated, we focused our grant resources in five areas

> 1 Infrastructure Development---most of what SERC provides to users is delivered in live video mode via satellite, which is the most cost effective way to deliver a video signal from a single point to multiple points across a wide geographic area Federal support allowed us to design and construct distance learning studios and production centers at four of our major public television course producers in geographically strategic areas around the country Federal support enabled us to provide uplink (transmission) equipment to these same four producers It enabled us to pay one-half the cost of nine hundred and four satellite downlinks (receivers) which can be

used not only to receive SERC programming but many other distance learning and related educational services These downlinks are located primarily at high schools in our member states Others are located at the head ends of other distribution systems such as cable systems, ITFS systems and public television stations. This last application allows the signal to be open-air broadcast across an entire state or portion of a state, as is the case in Mississippi, New Jersey, New York and South Carolina.

2. Interactivity---all SERC offerings use one or more types of interactivity to facilitate communication in the learning process. Federal funds were the primary source for creating our fundamental interactive strategies: two-way telephone connectivity through a sophisticated audiobridge, and keypad interactivity as it is used in the KET courses. SERC is now adding interactive capability through the Internet, although progress has been slowed because of the lack of federal funds

3. Instructional Design and Content---although much of the public focus of distance learning is on the technology, the core of distance learning resources, as with any educational resource, is the design and quality of instruction. As in the case of other federally funded educational projects, the first part of each two-year grant was spent creating the design, selecting materials and building an instructional team

4 Dissemination---There is a line in the movie, *Field of Dreams*, "if you build it they will come " This is not the case in distance learning One of the most difficult issues faced by SERC, its partners and al' other distance learning projects, has been developing the most cost-effective and efficient way of connecting potential users to appropriate resources Especially during the third funding cycle, SERC used a portion of its federal funds to get the appropriate information into the hands of decision makers in schools This issue remains critical as the choices, the confusion and the changing political structures at both the federal and state level impede the logical flow of information

5 Evaluation---During its two Star Schools funding cycles, SERC used an independent evaluation consultant to construct questionnaires and to conduct interviews with hundreds of students, teachers and school

administrators involved in the SERC experience From the beginning, this
feedback has been overwhelmingly positive For those who use distance
learning, as modeled by SERC, the experience clearly shows that learning
via distance learning provides at least as strong an educational experience
as traditional methods

What is missing from SERC's evaluation efforts, as with most other
distance learning programs is the comparison of base line data to normed
results in the various disciplines addressed by our courses This need will
be further expanded under recommendations

Results

After two cycles of Star Schools funding and six years of course offerings, SERC
now delivers nineteen full credit courses and a strong slate of professional development to
a large established base of schools equipped to receive a variety of distance learning
resources. Through a strong relationship with the public television community we are able
to take advantage of state-of-the-art satellite technology During the coming year, with
the strong support of public television, we will convert all our user schools and producers
to a digital compression system which will cut the cost of course delivery by more than
half Our educational partners in member state have identified priorities and needs for
future growth They have also addressed many of the regulatory changes needed to
integrate distance learning into the mainstream of our educational structures These
achievements are all important, but of course, the only true value of any project such as
SERC is the positive change it makes in individual lives

In the eastern hills of Kentucky, a young woman, a senior in high school, strong in
math skills, was encouraged to take a new course being offered in her small, rural school.
It was a course in discrete math offered via television and something called distance
learning At the time she began the course, she was also being encouraged to continue her
education in college She hesitated, though, because of the poor self-concept she had of
herself compared to the world beyond eastern Kentucky She took the course and
excelled, finishing with an A More importantly, she went on to college One of the major
influences in this decision was the fact that she participated in the discrete math class with
students from the suburbs of New Jersey, inner city Cleveland, and other small schools
like her own She learned first hand that she could hold her own in the academic
environment One might well ask, "What was the greater outcome of her distance learning
experience?"

Albert Moore, a student in Houlka, Mississippi enrolled in SERC's pilot semester of Japanese A few months later he spoke, in Japanese, before his state legislature Some time later he testified before the Congress of the United States, in Japanese (with suitable translation, of course). He also went on to college, using his unique learning experiences in both foreign language and math to gain entrance to a university and to complete his work with excellence

SERC's history is rich with report after report like these examples--testimonials to the positive impact distance learning has on individual lives

For those who still embrace the myth that distance learning is cold and impersonal, we have wonderful experiences to change that perception as well Pam Winders, the economics teacher for the course produced by south Carolina ETV, was the graduation speaker in Winnsboro, Louisiana, one of her distance learning schools Tim Cook, Nebraska's Japanese teacher visits schools around the country and is perceived as a close friend by his students, many of whom have never met him face to face but certainly know him from television, pictures, letters, e-mail and hours of telephone conversation

Concerns, Observations and Recommendations

After six and one-half years of existence how can an organization like SERC best benefit from a strong federal role? One of the issues we believe is most important has already been addressed by the Congress--the issue of the length of time a project will receive federal support Future rounds of Star Schools grants, assuming they remain funded, will be for five-year cycles rather than two This change will have a positive impact on several areas we believe are important as this young field continues to evolve The need to compete for scarce funds every two years and to demonstrate service in new areas, service to new populations and an emphasis on new technological constructs severely limits the ability of any project to explore and address the larger questions as to what models are most effective Often left out of any examination of a technology-based educational model, is the change that must occur in thinking and outlook as traditional organizations grapple with new and changing educational models Nowhere has this been more evident than in distance learning where new modes of learning cut across state boundaries and across hundreds of school districts, each with its own set of regulations and requirements Two years is too short a time to launch and stabilize any new learning model The time line becomes even more inadequate when one considers the evolution that must occur in the socio-political structures into which a distance learning model must be integrated

Parallel to the concern of project length, is our concern for **the need to balance the tendency to think, "if it's new, it must be better", with the need to stabilize and refine what exists.** All of us who read about the evolution and explosion of the information age know that technological advances occur rapidly. Technology that exists today will be better within a short period of time. On a personal level, if an individual makes the leap into the purchase of a home or office computer, he or she must understand that those choices will be cheaper or better within a six month period. That leaves two choices. One can focus on constantly trying to obtain the fastest, most powerful computer every six months or one can focus on optimizing the power and capability of the hardware and software he or she bought. The same choices face anyone who buys into the world of distance learning. There will always be new possibilities. There will always be exciting new models. Social constructs, however, are not as easily replaced as modems, videocards and memory chips--neither are distribution networks, interactive keypads and effective teaching models. Demonstration projects are important. A focus on demonstration models, however, ignores the need to create effective, flexible and stable learning models. We encourage legislation that recognizes and supports existing infrastructures, proven methods and prior federal investment. Such an approach does not necessarily lead to a protection of the status quo because this same legislation should favor those projects that combine the strengths of successful models with an integration of new possibilities. To some extent this has occurred with past and present Star Schools projects. A close examination of the evolution of the projects that continue, with or without federal support, will show, however, that there has been a need to emphasize "new and exciting" over stability and controlled evolution.

Closely linked to this issue is **long-range, formative evaluation.** Most of the efforts of the evaluation components of former and present Star Schools projects have focused on quantifying data and anecdotal reports of those participating in the projects. In an ideal world, one would compare baseline data regarding a participant's knowledge and skill level with changes that have occurred as a result of the distance learning experience. Creating such a structure requires much more effort than the types of survey instruments used in most projects. That effort is complicated by the fact that most distance learning projects offer new experiences which lead to new outcomes, for which no baseline data exists. The resolution of this problem is, again, related to time. Longer project cycles open up the possibility of more formative evaluation. They provide the opportunity to make meaningful changes while federal support is still available.

One of the decisions SERC made early on was the decision to charge for all services it delivers. This decision means two things. First of all, it provides a funding base for ongoing operations, whether outside funding sources exist or not. Even more importantly, it requires a by-in by the state and local educational institution and ultimately by the end-user. **Local participation and "ownership" is closely linked to the success of any regional or national educational effort.** We strongly encourage the Congress to continue to write legislation that requires a partnership between a national or regional provider and the local communities that ultimately benefit. This partnership should include not only shared responsibility for funding, but full participation in the decision-making process as well.

Mr. Chairman, in your charge to witnesses you asked us to comment on the role of the federal government in funding education technology. From the perspective of distance learning and Star Schools, I can say that without federal funding, distance learning would exist, but it would be different and almost certainly less effective.

One of the greatest strengths of distance learning is the fact that it crosses geographic, cultural and economic boundaries. As technology becomes more prolific, states, local school districts and individual schools can invest in the tools that allow them to communicate across distances. What they have more difficulty doing is building the infrastructure to take advantage of the elimination of geographic, cultural and economic boundaries. SERC students in New Jersey, North Dakota, Wisconsin, Georgia and Mississippi have participated in a dialogue with former president Jimmy Carter and his colleagues at the Carter Center in Atlanta, Georgia. Students from those and other states have discussed legislative issues with senators through the resources of the Senate recording studios. Students in affluent, suburban Austin, Texas "sit" side by side with students from Drew, Mississippi and Orangeburg, South Carolina in classes in Japanese and Russian. Without the support of the federal government, these linkages would most likely not exist. Just as with the interstate highway system, the creation of a technology infrastructure cannot be piecemeal. A strong federal role is critical to the successful outcome of this process.

Mr. Chairman, you also asked that we comment on the relationship of economic competitiveness to an educational technology infrastructure. Workers, even at the entry level, must be increasingly "literate" in their ability to access, interpret and act upon, information. Distance learning is about information and what we do with it, whether it be formal credit courses, interactive conferencing, or access to data through the Internet

Our economic world is rapidly becoming globalized Workers at all levels must think in terms of that global world In looking at the SERC model, it is important to know that for today's students, talking to a former president, a United States Senator, or a Spanish teacher from North Dakota, is, if not commonplace, certainly accepted as part of the way things are Today's students are much more at ease with the tools of technology than we will ever be Through informal distance learning, one can receive up-to-the-minute stock quotes, retrieve research data in Hebrew from Haifa University in Israel, tune in a current agricultural weather forecast or discuss pressing educational issues with peers from geographically dispersed, but similarly focused educational settings This is the world in which we live The "literacy" to embrace this world requires equitable access It requires a wide-range of tools and models Most importantly, it requires a high level of comfort and familiarity so the awe of the process does not overshadow the results of the interaction This kind of literacy is indeed vital to our nation's economic competitiveness It is vital to a strong democracy, and it is vital to the education process of the United States if these institutions are to remain relevant

I want to take this opportunity to thank the Congress of the United States for the support you have given SERC and for the support you have given and are giving to other projects with similar but diverse models and missions I also want to thank you for the opportunity to share these thoughts, ideas and experiences Unfortunately, there are no easy answers because we don't even know all the questions Through the continued support of the federal government, we have the best chance of working in a coordinated, logical way to deal with the opportunities as they arise, the questions as they are raised, and the answers as they are tested, revised and proven

STATEMENT OF WALT HINDENLANG, PRESIDENT, HUGHES ELEC-TRONICS GALAXY INSTITUTE FOR EDUCATION, EL SEGUNDO, CA

ACCOMPANIED BY BEN CASADOS, EXECUTIVE DIRECTOR

Senator COCHRAN. Now, we go to Hughes Electronic Galaxy Institute for Education. Mr. Walt Hindenlang is president. Mr. Ben Casados is executive director. I understand Mr. Casados will present the statement to the committee.

You may proceed.

Mr. CASADOS. Thank you, Senator Cochran. It is, indeed, an opportunity to testify before this committee.

I also serve as the industry representative to the California Education and Learning Council, and was part of the council that created the California technology plan.

Let me begin by emphasizing how critical technology-literate workers are to modern industry and to companies like Hughes Electronics. Let me tell you briefly why this company initiated a significant effort to enrich the education of our children.

Hughes' employees, like employees throughout our industry, must be technology literate and technology advanced. They must be scientifically and mathematically competent.

They must possess critical thinking skills and reading skills, and the work force must reflect our diverse population, so that we will be better able to communicate with our global marketplace.

Like others in p.·ivate industry, we were very concerned about how low test scores were of American students in science and math, and we felt it was our corporate responsibility to help better prepare the work force of the 21st century.

To that end, Hughes initiated the Galaxy classroom project in 1990. Our goals for the project were fourfold, to combine our technical expertise in telecommunications technology with that of educators and parents; to improve student achievement in science and language arts by creating a curriculum fully integrated with technology, professional development, and parental involvement; to measure the results of our efforts qualitatively and quantitatively, and based on those results, implement a plan for a scaleup; and to leverage technology to create a nationwide program.

With the Galaxy classroom, we created a national satellite education network for elementary schools, utilizing satellite transmission, fax machines, television, and computers.

The demonstration phase of the Galaxy classroom was a partnership of educators, parents, government foundations, and business leaders in 40 schools in rural and urban States, in 21 States.

Hughes Electronics committed more than $20 million to this effort, and this project would not have come to fruition without additional support from the National Science Foundation, which provided $4.2 million to create our science curriculum. Other foundations were also important partners in this venture.

What did we learn? In short, the efforts that integrate technology and interactive curricula with professional development can dramatically improve student achievement on a nationwide basis.

I have submitted the executive summaries of our curriculum evaluation with this testimony.

Widespread of technology is critical in meeting the national education goals, because in many ways, technology is a great equalizer that can help us create high-performance learning environments, where all children can reach high standards.

Technology can empower rich and poor students alike in dramatic ways. It provides access to information and rich curricula resources. It promotes individualized learning and collaboration, unbounded by the physical limitations of place and time, or the personal and cultural characteristics of the participants.

We must acknowledge the value of integrating technology and education in much the same way we see its value in the work place, as an indispensable tool that helps us produce better products and services, and achieve greater economies of scale.

Like most of us in this room, my office contains technologies that are not extraordinary for the office environment, but they are certainly for the school environment.

Among them is a telephone and a fax machine, something that few teachers in this country have at their desks. Yet no one in this room would ever doubt the benefit in the workplace.

Why are we so willing to accept less in terms of technology with which we equip our schools, when at the same time we are demanding more from our schools, from our teachers, and from our students?

Where do we go from here? Because of the many great ideas generated by education reform, coupled with the powerful technologies now available, this ought to be a renaissance period for teaching and learning in the United States, but in most school districts, it is not.

I am convinced it will require strong leadership, commitment, and financial resources from private industry, Federal, and local governments together to transform our schools into institutions where students are prepared to lead full and productive lives.

I am pleased to hear discussions this morning on the national blueprint. We must have a national framework for technology implementation that provides schools and school districts with guidelines, flexibility, assistance, encouragement, and financial resources. The plan must be designed to serve all students.

The Federal Government should play an important role in the leadership and funding of nationwide integration of technology and education. Here are three suggestions.

I would suggest that we create a national trust fund to build a national technology infrastructure for education in much the same way we created the National Interstate Highway System that extends from coast to coast.

The interstate highway system was funded from a dedicated gasoline tax stream. Those funds were allocated to each State, based upon miles of interstate within boundaries. A State-matching formula was also part of the funding.

The security concerns that promoted then-President Eisenhower to call for the creation of a highway trust fund to build an interstate system has given way to the global competitiveness concerns of the new millennium.

Continue to invest in exemplary educational technology programs at the local level. Programs like Star Schools and others included in title 3 are critical research and development efforts that will enable our schools to better understand, implement, and benefit from educational technology.

At the same time, however, we cannot afford to continue to create good, but small isolated successes. So these projects must be rigorously assessed and evaluated against benchmark criteria, and based on their successes, be sustainable, affordable, and scaled up to meet the national needs.

Lead a national effort in professional development. We now have rich and varied teaching tools, and very few teachers who know how to effectively use them.

Many of today's educators have not been provided the training to use basic technologies, let alone to effectively integrate these technologies with classroom curriculum.

What I propose goes against the grain of current devolution thinking prevalent within this city and within this body.

Now, while I recognize, too, that education is generally the province of States and localities, I also believe that because the education of our youth will ultimately define the capabilities of our Na-

tion, the Federal Government should be vigilant in meeting the needs of our Nation's education system. It must lead a national effort to integrate the use of technology in the classroom.

PREPARED STATEMENT

At the Galaxy classroom, our goal for the future is very ambitious, to reach 20 million students in 10,000 schools by the year 2000. The goals for the Federal Government for this Nation's students should be no less ambitious.

Thank you, Senator.

Senator COCHRAN. Thank you, Mr. Casados, for your excellent statement.

[The statement follows:]

STATEMENT OF BENITO CASADOS

Mr. Chairman. thank you for the opportunity to testify before the Senate Committee on Appropriations. Subcommittee on Labor. Health. Human Services and Education as you examine the appropriate federal role in funding programs that support the integration of technology in K-12 education.

I am Benito Casados. Executive Director of Education Systems for the GALAXY Classroom. With me today is Walt Hindenlang, President of the GALAXY Institute for Education, a not-for-profit entity created by Hughes Electronics (formerly Hughes Aircraft). Mr. Hindenlang is available to answer any questions you may have as to why Hughes Electronics has been the major underwriter of the GALAXY Institute. My background and experience with education technology began as Director of Educational Services for Jet Propulsion Laboratory in Pasadena. In this role in the 1970s. I used satellite technology to bring into the nation's classrooms, planetaria and museums. the historic landings of the Viking One and Two on Mars. and later the close encounters of the Voyager One and Two spacecraft with the planets of Jupiter and Saturn. Through this early use of telecommunications. students and teachers witnessed in real time. vistas of these colorful and stormy worlds. These efforts are considered by many to be the first significant educational technology initiatives and are wonderful examples of how the participation of the federal government. working with private industry. accelerated the use of emerging technologies in the education arena.

I also serve on the State of California's Council for Technology and Learning and its predecessor the California Education Technology Commission, which designed the California state K-12 Technology Plan. I believe my experience in each of these organizations is helpful to our discussion today.

One of the issues you have asked us to address is the importance of technology-literate entry level workers in economic competitiveness. Let me begin by emphasizing how critical technology-literate workers at all levels are to modern industry and to companies like Hughes Electronics and why this company initiated a significant effort to enrich the education of our children.

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This nation is the world leader in the design, manufacture and marketing of advanced electronic systems. We are the world's leading developer and manufacturer of commercial communications satellites and satellite-based communications systems and services to the worldwide telecommunications market.

In fact. Hughes Electronics itself is the leading manufacturer of commercial communications satellites. having produced 40 percent of the satellites currently in service around the world and owning and operating the Galaxy fleet of 14 commercial communications satellites. In addition. Hughes Electronics is the leading supplier of satellites and scientific instruments for a variety of defense. NASA and other government space missions.

In recent years, Hughes, as well as other companies, has also intensified its focus on global markets by forming new international business partnerships in Europe. the Middle East. South America and Asia and the Pacific Rim.

Our employees today, like employees throughout our industry, must be not only technologically literate, but technologically advanced; and, they must be scientifically and mathematically competent. They must possess critical thinking and reasoning-skills. Our workforce must reflect the emerging diversity of the population so we will be better able to communicate in the global marketplace.

Like other corporations, Hughes Electronics believes in helping the communities in which we operate and the larger society of which we are a part. Our continuing commitment to education, in particular. is evident not only through formal programs and contributions but also through the work of employees and retirees who volunteer their time and skills to enrich the education of students in elementary and secondary schools.

The creation of the GALAXY Classroom in 1990 exceeded any previous philanthropic endeavor by Hughes Electronics. Like others in private industry we were very concerned about the low

·st scores of American students, in particular, their low achievement in science and math. And
e believed that we could help meet the critical need to improve student achievement and
repare them for the workforce of the 21st century.

herefore, our goals for the GALAXY Classroom were four-fold:

- To apply our technical expertise in telecommunications technology with the
  expertise and perspectives of teachers, principals, educators, as well as the
  creative community of producers and writers to create a program that would
  improve elementary education. We believe that it is critical to affect stud. ;
  achievement and attitudes in early education, when students are still forming their
  attitudes about learning and their self esteem;

- To focus our initial efforts on science and on language arts to help students
  improve achievement in these areas and thereby help meet critical workforce
  needs for the next century;

- To measure the results of our efforts qualitatively and quantitatively so that we
  would know how and why our efforts were improving elementary education: and
  based on those results to implement a plan for "scale up;" and.

- To create a program that was national in scope and not dependent upon the
  location of Hughes' facilities. Our workforce will be drawn from every region of
  this country and our experience tells us that many well-intentioned projects have
  produced only small pockets of excellence around the country. Our goal was and
  remains very ambitious -- to reach 20 million students in 10,000 schools by the
  year 2000. We believe that through partnerships between industry and
  government we can achieve positive change on a grand scale.

With the GALAXY Classroom we created a satellite education network for elementary schools designed to integrate and interactive science and language arts curriculum with telecommunications technology. The project aims, first, to engage and motivate elementary students and increase achievement. It also aims to expand the knowledge base of teachers and administrators, establish satellite and interactive technologies for schools, increase the involvement of parents and caregivers in the education of their children, and help children understand and appreciate the role of modern technology in their daily lives and as tools for learning.

The demonstration phase of the GALAXY Classroom was a partnership -- of educators, parents, government, business and foundation leaders and schools. Initially we selected 40 rural, urban and suburban schools in 21 states, the District of Columbia and Mexico to test our concepts of integrating technology with an interactive science and language arts curricula. Today, in our first year of national service, our satellite education network now links more than 51,000 students in almost 500 schools in 24 states through a communications network of video, fax and E-mail.

Hughes Electronics committed more than $20 million to this effort, creating an interactive network linking classrooms across the country through the technology of satellite dishes, televisions and VCRs, fax machines and the associated wiring for our demonstration schools. This effort, however, would not have come to fruition, without the support of the National Science Foundation, which provided $4.2 million to create our science curricula for grades 1 and 5, the Carnegie Corporation of New York, Weingart Foundation and Stuart Foundations, which provided additional resources for professional development, as well as other smaller foundations and individuals who have been important partners in this venture.

What have we learned?

First, as we worked with school districts across the country we developed a new appreciation for the tremendous needs in our public schools; and secondly, that efforts such as ours that integrate technology and interactive curricula can dramatically improve student achievement.

An independent evaluation conducted by Far West Laboratory for Educational Research and Development concluded that GALAXY Classroom students gained nearly twice as much as comparable students in overall reading and reading comprehension test scores and they also made significant gains in vocabulary development. Far West's evaluation of the science curriculum concluded that the program is meeting its goal of fostering the development of scientific process reasoning in students. Fifth grade students, for example, were better able than their non-GALAXY peers to understand and construct knowledge and call on core science concepts and thinking skills that are fundamental to understanding science.

Significantly, all gains noted by Far West in all evaluations of GALAXY students are independent of gender, ethnicity, economic status, or home language other than English. For your information and referral I have submitted the executive summaries of each evaluation with this written testimony for the record.

There is also significant value in this program beyond its test results. Principals and teachers have reported to us that there are fewer absences from GALAXY schools, fewer discipline problems, increased desire to read and write and increased student motivation. These indicators are directly attributed to the involvement of children with technology, along with a curriculum that makes students active participants in their own education.

Our goal in integrating technology into curriculum, in GALAXY Classroom or any other project, is to create a collaboration between teachers and technology that engages students in their education, makes them more active learners who seek and assess information. Technology has the potential to overcome restrictions of time and space, enabling students to learn more, in less time and with far less overhead.

I believe that the widespread use of technology is critical to meeting the national education goals, because in many ways technology is a great equalizer that can help us create high-performance learning environments where *all* children can reach high standards.

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Technology can empower children in dramatic new ways. It provides access to information and rich curricular resources. It promotes individualized learning and collaboration. unbounded by the physical limitations of place and time or the personal characteristics of participants. It presents students with a new context for thinking and interacting and unprecedented opportunities for exchanging ideas and information that can enrich teaching and learning. It invites inquiry and enables students to communicate with their learning peers nationwide. and even worldwide. It enhances problem solving abilities, creativity and critical judgements.

There has never been a time when new tools stood to change so much in education: from how students have access to information and can learn in new ways: to teaching strategies and methods and curriculum design: professional development; bilingual education: classroom management and school administration.

To achieve these goals. however. we must do more than simply introduce technology into existing school cultures and frameworks. If technology is to truly transform teaching and learning it must become an integral part of classroom teaching strategies. Administrators. teachers. students and parents must learn how to use it effectively.

I believe that we should begin to recognize and acknowledge the value of integrating technology in education in much the same way we see its value in the workplace -- and that is as an indispensable tool that helps us to work more effectively and efficiently to produce a better product and/or service and achieve greater economies of scale.

Like most of us in this room my office contains a high-powered computer with CD ROM and a range of software appropriate for my business, an on-line service that provides me with access to almost unlimited resources, information and communications that enables me to do my job better. In addition I have a telephone -- *something that few teachers in this country have at their desks* -- and a fax machine. And my office also contains a small 18 inch DIRECTV satellite

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dish sitting on my window sill pointing south. That dish brings me the GALAXY Classroom, plus 150 channels of programming.

Except for the satellite dish and the 150 channel capability on my television. what I have described is not extraordinary for an office environment. But it certainly is for a school environment. And we are gathered today to discuss the benefits of technology to education. Yet no one in this room would ever doubt its benefits in the workplace. Why is that? Why are we so willing to accept less in terms of the basic tools and resources with which we equip our schools, when. at the same time. we are demanding more from our schools. our teachers and our students?

Where do we go from here?

Because of the many great ideas generated by education reform and because of the wonderful technologies now available. this ought to be a renaissance period of teaching and learning in the United States. But in most schools and school districts it is not.

Why? Because schools across the country are still faced with deteriorating structures. severely limited budgets that virtually curtail the purchase of new tools and resources, issues related to discipline and safety, children who enter school unprepared to learn and teachers without the opportunity to communicate and learn and share new teaching strategies.

The bottom line is that it is going to take *strong leadership, commitment and financial resources* from private industry and the federal government -- together -- to transform our public schools into ones that we can all be proud of -- and that turn out students who are prepared to lead full and productive lives.

Private industry alone cannot do it. Initiatives of the magnitude of the GALAXY Classroom are exception, not the rule.

We must have a national plan or framework for technology implementation that provides guidelines, flexibility, assistance, encouragement and financial resources for schools and school districts as they grapple with this complex issue. That plan must be designed to reach *all* students.

The federal government can and should play an important role in the leadership and funding of the nationwide integration of technology in education. Here are three suggestions:

1.   Create a national education technology trust fund. We should look at creating a national technology infrastructure for education in much the same way we created the national interstate highway system that extends from coast to coast. The interstate highway system was funded from a dedicated gasoline tax stream. Those funds were allocated to each state based upon the miles of interstate within state boundaries. A state matching formula was also part of the funding system. The federal government also took upon itself to attract great technical minds to the task and to fund pilot projects and underwrite research.

    The security concerns of the 1950s that promoted then-President Eisenhower to call for the creation of a highway trust fund to build an interstate highway system have given way to global competitiveness concerns of the new millennium. Frankly there can be no doubt about the effectiveness of technology as a tool and resource in education. And there can be no doubt about the importance and urgency of this issue. We are a mere five years away from the 21st century.

    I think the highway model is one we should look at to help meet the critical needs of our schools and students.

2.   Continue to invest in exemplary education technology programs at the local level.
     Programs like Star Schools and those included in Title 3 of the "Improving America's

Schools" Act are critical research and development efforts that will enable our schools to better understand, implement and benefit from educational technology. At the same time however, we cannot afford to continue to create good, but isolated successes. And so I would add that these projects must be rigorously assessed and evaluated against benchmark criteria, and based on their success, be sustainable, affordable and scaled up to meet nationwide needs. We must not only make them available to schools and communities nationwide, we must be aggressive in making schools and communities nationwide aware of what is working; and

Lead a national effort in professional development. My concerns in this area are many. We now have rich and varied teaching tools and very few teachers who know how to effectively use them. Some know how to use one kind of computer or a software program. However, many of today's educators are wholly unprepared to use basic technologies such as personal computers, fax machines, videodisc, E-mail or even a VCR -- let alone to effectively integrate these technologies with classroom curricula. Over the past three years in my role with the GALAXY Classroom I have witnessed good teachers of all ages who have never faxed a document, recorded a television program or even used a computer. They are dedicated teachers who have never become technology literate and who are struggling to be teachers of today.

The workforce of the future is in the hands of our teachers. We must create the teachers of tomorrow today.

It will not be easy and we will probably be into the next century before we see a critical mass, but we must act today.

What I propose goes against the grain of the current "devolution" thinking prevalent in this city and within this body. And while I, too, recognize that education is generally a province of states and localities, I also believe that because the education of our youth will ultimately define the capabilities of our nation, the federal government should be vigilant in meeting the needs of our nation's education system. Through the Department

of Education it must lead a national effort to integrate and use technology in the classroom. And this is a case where the message is the med!...m The very economics of scale and reach offered by telecommunications technology must be employed to provide professional development models for teachers nationwide.

GALAXY CLASSROOM SCIENCE EVALUATION FOR GRADES 3-5

> *"GALAXY has enriched my teaching. It has made me enthusiastic and happy about teaching science. I have enjoyed and learned a lot about how children learn, i.e., investigate, explore, share. Having the materials readily available has been GREAT. My teaching has been RECHARGED!!!"*
>
> — GALAXY teacher from California

The Galaxy Classroom is a package of integrated curricular and instructional approaches, supported by the nation's first interactive satellite communications network designed to facilitate the introduction of innovative curricula to improve student learning in elementary schools. Challenging curricula and learning experiences are made available to all students, including those who ordinarily lack such access.

GALAXY Classroom Science for Grades 3-5 features the organization of instruction around themes presented through television broadcasts and classroom hands-on activities that are facilitated by fax technology and ongoing teacher support. The broadcasts are built around a video adventure series that dramatizes the GALAXY themes through the real-world adventures of a multicultural group of students, THE S.N.O.O.P.S. The stories feature characters with whom students can identify and who model for students the use of various scientific techniques and processes to explore and understand their world.

The evaluation found that GALAXY science for grades 3-5 is a highly successful initiative:

* On measures of classification processes, GALAXY students had a statistically significant gain that was more than double the gain of non-GALAXY comparison students.

* Scores on curriculum-based performance assessments indicate that the majority of GALAXY students across all three grades were able to demonstrate that they understood the "big ideas" or core science concepts of the GALAXY curriculum.

* In general, when comparison non-GALAXY students were evaluated on some of the same measures, GALAXY students outperformed them in almost every case.

* In addition, GALAXY teacher- displayed significantly more positive attitudes than they had initially regarding their own comfort with and preparation for teaching science and the adequacy of their science materials.

* Participating in GALAXY Classroom Science led to statistically significant positive changes in attitudes among GALAXY students, when compared to their non-GALAXY peers, toward participating in science class and engaging in activities to which they did not know the right answer.

Evidence from the evaluation shows that GALAXY works: in GALAXY classrooms science is being regularly taught, students are learning, and teachers are developing a new enthusiasm for science and science teaching. The evaluation further shows that the whole of GALAXY science is greater than the sum of its parts. The components by themselves represent exemplary efforts in science education. Together, they create a powerful package.

> *"We get to touch things and discover stuff."*
>
> — GALAXY student

The GALAXY Classroom Project was developed as a nationwide reform effort to infuse new student-centered curricula into elementary schools, to spark the interest of teachers and students in learning, and to provide innovative educational opportunities for all students including those who have traditionally been considered academically "at risk."

GALAXY Classroom Science for Grades 3-5

The curriculum for GALAXY Classroom Science for Grades 3-5 is built upon the fundamental view that students can construct knowledge about science from the content and context of their daily lives. GALAXY's goals for elementary science have been three: to foster the development of the thinking processes that are tools for constructing knowledge of science (e.g., observing, communicating, comparing, organizing, relating), to provide students with some of the "big ideas" or core science concepts that are fundamental to understanding science, and to aid teachers through ongoing professional support.

> "Although I am a veteran teacher, I felt at a loss as to how to teach science. The concepts of the arcs [themes] — patterns, experiments, and black boxes — made sense to me.... I could teach the concepts rather than information and knowledge I frequently lack." — GALAXY teacher from California

The "big ideas" are communicated through the GALAXY inquiry-based, hands-on/minds-on science curriculum which is organized around three six-week themes: (1) using patterns as evidence, (2) doing experiments to describe and compare materials, and (3) building models to explain and invent ideas. Each of these themes was designed to be age-appropriate; to use investigations that teachers can expand; to work in an interdisciplinary science program; and to support national, state, and local frameworks and standards.

The Evaluation Approach

The Far West Laboratory for Educational Research and Development (FWL) conducted a comprehensive evaluation of the implementation and impact of GALAXY Classroom Science for Grades 3-5 for the initial demonstration phase.

The evaluation gathered quantitative data on GALAXY's impact by testing student learning through performance-based assessments, surveying student and teacher attitudes and teacher practices, and asking teachers to record their use of the GALAXY Classroom Science curriculum. Performance-based assessments, in contrast to most multiple-choice tests, ask students to do something and then record what they have discovered. Administration of four of the performance-based assessments and the attitude surveys followed a pre/post design. Four other assessments were more closely linked to the curriculum and activities, and they were administered during the course of GALAXY science.

In addition to these quantitative measures, a series of observations and interviews were carried out in five case study schools throughout the country, with shorter visits to several other schools. These case study classrooms were spread across the nation and varied in the ethnicity of the students as well as whether their setting was urban, suburban, or rural.

GALAXY Classroom Science for Grades 3-5 Demonstration Program

GALAXY Classroom Science for Grades 3-5 is a package of integrated curricular themes and hands-on science activities. Instruction is organized around three themes presented through television broadcasts and classroom hands-on science activities and supported by the use of fax technology in the classroom and take-home science activities.

During the demonstration phase for GALAXY Classroom Science for Grades 3-5, classrooms in thirty-eight schools (later forty) were connected by an interactive satellite communications network. The demonstration phase ran for eighteen weeks of class time in the fall of 1993 and winter of 1994.

> "[GALAXY] worked well with all students because of high interest cliff-hanger broadcasts backed up with interesting, program-coordinated hands-on learning activities." — GALAXY teacher from West Virginia

Broadcasts The television broadcasts dramatized the GALAXY themes through а. continuing program about the adventures of a multicultural group of students, THE S.N.O.O.P.S., interacting together as they solved various mysteries. The stories featured characters with whom students could identify and modeled for students the use of various scientific techniques that the characters employed to solve the problems and puzzles they encountered.

"The program hooks in all kids because they can relate to it."
— GALAXY teacher from California

"They put your name on TV! We can't wait 'til the program comes on again."
— GALAXY student

The evaluation found that students were entranced with the broadcasts; the broadcast mysteries received the highest ratings from students at case study schools among all the GALAXY components about which they were asked. Similarly, more than 90% of. the teachers who completed the end-of-year survey judged the broadcasts to be of "great educational value."

Hands-on Activities Each classroom used a set of GALAXY-provided hands-on science kits that are parts of the Great Explorations in Math and Science (GEMS) or the Full Option Science System (FOSS) curricula, both developed by the Lawrence Hall of Science at the University of California, Berkeley.

"Hands-on activities are wonderful. These activities really reach the interest levels of all students."
— GALAXY teacher from West Virginia

FWL evaluators found that both teachers and students were extremely pleased with the GALAXY hands-on materials and activities. Teacher enthusiasm at case study sites stemmed from having all the materials they needed and receiving them at one time, using the GEMS and FOSS guides that were easy to follow and adapt for their classes, and knowing that students loved the activities and were therefore eager and interested learners. This enthusiasm was echoed in the end-of-year survey when nearly all the teachers rated the activities as having "great educational value."

"Hands-on activities and take-home kits made the kids feel like they could do anything."
— GALAXY teacher from Indiana

Teacher enthusiasm was tempered in a few cases by factors such as the significant amount of time necessary for setup, the inevitable mess associated with hands-on materials, and the perception among some teachers that a few of the activities were too difficult for third graders. In addition, some teachers thought that the Teacher's Guide could have provided more assistance on how to link the ideas and themes of the broadcast with the hands-on experiences.

Students were, if anything, even more enthusiastic than their teachers about the hands-on activities. More than 90% of the interviewed students gave the activities their highest rating.

Fax One of GALAXY's unique features is facilitating student and teacher interaction with one another across the city or across the country and with the broadcasts' producers through a dedicated satellite network and classroom fax machines.

"I think that GALAXY Science worked well with all of my students because their ideas were recognized no matter what they submitted (i.e., pictures, photographs, etc.)."
— GALAXY teacher from Massachusetts

Interviewed students were very positive about faxing, some citing the chance of seeing their names in the broadcast. Additionally, many of the students' ideas that were sent to Database (headquarters for THE S.N.O.O.P.S.) appeared in *The Scoop*, a two-page fax bulletin that was sent periodically to GALAXY classrooms. However, fax problems prevented some classes from receiving it.

Teachers also valued faxing, with more than 80% of teachers who responded to the end-of-year survey rating sending faxes as having "great educational value" for their students and more than 70% reporting that students were "very enthusiastic" about sending faxes to Database. An even higher proportion of teachers said that their students were "very enthusiastic" about seeing their names and/or faxes on the broadcasts.

> *"The fax machine is integral. The kids were disappointed when they worked for days on faxes to S.N.O.O.P.S. and missed the fax deadline because our fax machine did not work."*
> — GALAXY teacher from Wisconsin

During the demonstration phase, technical difficulties produced frustration for many teachers. Only 12% reported that their fax machine always worked, and others commented that they were never sure whether their faxes reached their destinations. When these kinds of technical problems occurred, whether at the classroom, school, or network level, students became disappointed: "Our faxes never got to Database — they got ate up by the satellite."

FWL evaluators concluded that, when the fax machines worked, they provided powerful motivational incentives for GALAXY students.

Snoopers Loop Take-Home Kits Materials for each theme included four different home investigation science kits that students were encouraged to explore with family members and friends. All the necessary materials plus instructions for doing an investigation at home with an adult were included in each kit.

> *"My class begged for the take-homes. Please keep them in."*
> — GALAXY teacher from Pennsylvania

Each of the take-home kits arrived at school in parts and required time for assembly (e.g., placing each of the parts and instructions in plastic bags). While some teachers asked parents to help put together the kits or held a "family science night," others were overwhelmed by trying to do it themselves. However, even though preparing the kits was fairly labor-intensive, they were rated well by both students interviewed (more than 70% at case study sites) and the majority of teachers (more than 60% rated them as "very useful" and having "great educational value").

Recognizing that there is a progression to the development of scientific thinking skills, researchers at FWL adapted four performance-based assessments from the California Learning Assessment System (CLAS) to test GALAXY and comparison students' progress in several crucial areas. FWL researchers measured classification and organization (critical components of scientific thinking for grades 3-4 and 5-6) with two hands-on assessments using fossils in the pre-test and leaves in the post-test. Skills related to experimentation were measured by two other pre/post performance-based assessments using rocks and soils, which were administered in a crossover design. Additionally, students took a multiple-choice test of science process skills.

Results from the Classification Pre/Post Assessments

The evidence shows that participation in GALAXY had a statistically significant positive effect on students' classification abilities. These results are based on testing 600 GALAXY and 610 comparison students in the same grades at twelve GALAXY schools. Each of the two assessments had three tasks that were scored from 0 (no attempt) to 5 (accurate and informative). Figure 1 shows the average (mean) scores for GALAXY and comparison

students in each of the three grades, both before GALAXY science started (pre) and after it was completed (post).
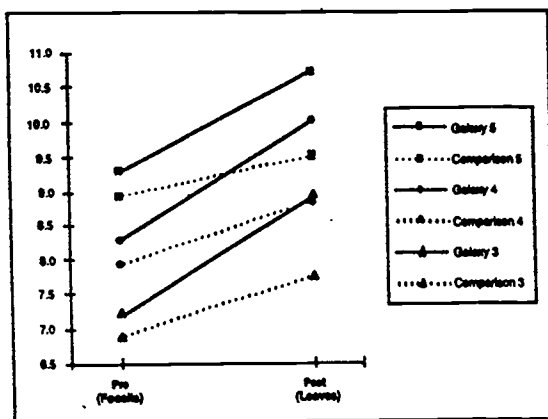
Figure 1. Pre/Post Mean Total Scores on Classification Tasks

- GALAXY students had statistically significantly greater gains than comparison students on each of the three classification tasks in the assessments. (Task 1: .50 vs. .19, p<.001; Task 2: .34 vs. .11, p=.016; Task 3: .79 vs. .48, p<.001).

- GALAXY students had statistically significantly greater gains than comparison students at each grade level (third, fourth, and fifth).

- Figure 1 illustrates the GALAXY and comparison mean gain at each grade for overall classification scores (the sum of the three individual task scores). *The most dramatic result is that, for third and fourth grades, GALAXY student post-test scores surpassed not only those of their grade level counterparts but also the pre-test and post-test scores of comparison students in the next grade.*

- Looking at all the data from all three grades together, students who participated in GALAXY science had a statistically significant gain in classification abilities that was more than double that of comparison students (1.63 vs. .79, p<.001).

- The gains measured by this assessment were similar across all three grade levels and unaffected by gender, ethnicity, Chapter 1 status, language spoken at home, or previous participation in GALAXY Language Arts.

- GALAXY is appropriate for both high-achieving and academically at-risk students as evidenced by fairly similar gains for students regardless of their initial performance on these assessments.

Observing, communicating, comparing, and classifying are crucial scientific thinking processes for students in grades 3-5. Based on the results of the classification assessments, GALAXY appears to have met the goal of fostering the development of these processes. *Indeed, the results suggest that GALAXY science can work for every type of student and can carry many of them up to a par with students who are a year ahead of them.*

Results From Pre/Post Assessments of Experimental Skills

During the fifth and sixth grades, students expand their repertoire of scientific thinking skills to include the abilities to recognize relationships between ideas and to design simple experiments. During this period students also develop the ability to isolate and manipulate variables in an increasingly systematic manner.

Researchers at FWL tested these experimental skills by adapting two existing CLAS performance-based assessments to use in a pre/post crossover evaluation design. GALAXY

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and comparison students participated in either the Rocks or the Soils assessment as a pretest and the other as a post-test. Unlike the classification assessments, which yielded results for individual students, the assessments of experimental skills gave information about groups of students. Because the skills being measured were known to be developmentally beyond most third graders, the tests were administered to fourth and fifth graders only.

Results from the Rocks Assessment

The patterns of scores shown by fourth and fifth graders on the four tasks of this assessment reflect the difference in their developmental levels of understanding about experimentation.

Results for fourth graders indicate no pattern of significant change on this test. Although some growth is evident, neither comparison nor GALAXY fourth graders show gains that are statistically significant.

In contrast to the results for fourth graders, an interesting and promising pattern emerges for GALAXY fifth graders on the essential components of the test, particularly in independently repeating experiments (Task 2) and in using evidence to support experimental conclusions (Task 4).

- On Tasks 2 and 4 of this assessment, the post-test GALAXY fifth grade cohort shows statistically significantly higher scores when compared to pre-test GALAXY students.
- GALAXY fifth graders performed statistically significantly better than comparison students on Task 2, and, although GALAXY students display greater gains than comparison students on Task 4, it falls short of statistical significance at the .05 level (p=.084).
- Results from the other two tasks indicate no real difference between the GALAXY and comparison fifth graders.

Although the Rocks assessment did not prove to be an age-appropriate measure for fourth graders, several of its components did help to demonstrate that *fifth graders who participated in GALAXY Science were better able than their non-GALAXY peers to recognize relationships, isolate and manipulate variables in an experiment, and generalize information to new situations.*

Results from the Soils Assessment

The Soils assessment, like the Rocks assessment, tested more advanced scientific thinking processes: observing, understanding relationships, and making simple inferences and predictions. Similar to findings from the Rocks assessment, the developmental differences between fourth and fifth graders appear to be reflected in the results.

The fourth grade results for the Soils assessment show little difference in performance between GALAXY and comparison students. The results for the fifth graders indicate both that the test was more appropriate for these students and that GALAXY students outperformed their comparison counterparts:

- The vast majority of GALAXY and comparison fifth graders got good scores on Task 1 for both pre-tests and post-tests. It would appear that this measures something that they already know (how to replicate an experiment and observe accurately).
- Task 2 shows a statistically significant positive change for GALAXY fifth graders and a smaller, not statistically significant, change for comparison students, but the difference in their growth was not statistically significant.
- On Task 3, GALAXY fifth graders showed a statistically significant gain between the two administrations (from 1.24 to 1.74, a gain of .50). The two groups of comparison students scored roughly the same at pre-test and post-test (1.43 and 1.40), indicating that they had not learned much in this area. The difference in gain is statistically significant (p=.01). These results suggest that students participating in GALAXY had learned more than comparison fifth graders about generalizing information they had just learned to a new situation.

The fifth grade results from the Soils assessment and, in particular, Task 3, indicate that GALAXY Classroom Science helps foster the development of scientific thinking processes, in particular comparing variables, relating procedures, and solving new problems.

Results from the Science Process Assessment

FWL administered a multiple-choice test of scientific thinking processes, the Science Process Assessment, developed in the late 1980's to reflect curricular reform in Pennsylvania. This test was selected to assess scientific thinking in areas not specifically addressed in the GALAXY curriculum. Figure 2 shows the results in terms of mean total scores.

The results are ambiguous for the fifth grade, but they are more clear for the fourth grade.

- The data suggests that students in fourth grade GALAXY classrooms learned an array of scientific reasoning skills reflective of the new reforms in science education (particularly forming hypotheses and experimenting) better than their peers in comparison classrooms.

- GALAXY fourth graders had gains on the thirty-one item test that were statistically significantly greater than those of comparison students (1.93 and .05, respectively, p<.001).
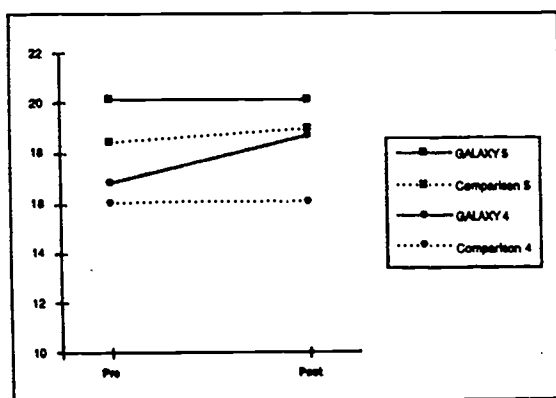
Figure 2. Mean Total Scores on Modified Science Process Assessment for GALAXY and Comparison Students

These results, comparing GALAXY and non-GALAXY students, suggest that GALAXY science can contribute to the development of scientific thinking processes among fourth graders.

FWL evaluators devised a series of four curriculum-embedded performance assessments to evaluate students' understanding of the "big ideas" presented in the three themes of the demonstration phase curriculum. GALAXY classrooms were asked to participate in all four embedded assessments; comparison students participated in two. In addition, small groups of students were videotaped while working on tasks related to the core science concepts of the three themes.

Results for Theme 1: Science is Finding Patterns as Evidence

The GALAXY curriculum for Theme 1 had students viewing broadcasts and participating in activities that focus on recognizing and using patterns as evidence to solve crimes or explain events. Results from both the Theme 1 videotaped performance assessment and the performance-based embedded assessment (*Reading the Beach*) show that a large majority of third, fourth, and fifth grade GALAXY students understood and could apply what they had been taught about finding and using patterns as evidence.

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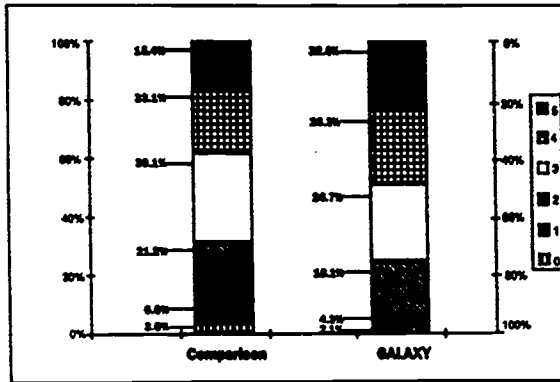
Figure 3. _Reading the Beach_ Scores for Comparison and GALAXY Students

- The overall difference in the distributions of scores between GALAXY students and non-GALAXY comparison students, as shown in Figure 3, is statistically significant (chi-square=17.98 with 5 d.f., p=.003) and indicates that GALAXY students outperformed their comparison peers on this assessment.

- As Figure 3 shows, 75.5% of GALAXY students demonstrated a level of competence or better (score of 3, 4, or 5 out of 5) compared with 68.6% of comparison students.

On the embedded assessment for Theme 1, in which comparison students also participated, _GALAXY students demonstrated that they were more skilled at recognizing, using, and interpreting patterns than their non-GALAXY peers._

Results for Theme 2: Science Is Doing Experiments

Theme 2 focused on the core concept of doing experiments to describe and compare materials. GALAXY Classroom students joined the broadcast characters in trying to solve mysteries through hands-on experimentation with familiar materials. The purpose of the FWL videotaped assessment in this theme was twofold: to see if GALAXY facilitated students' working in small cooperative groups and to determine if GALAXY students approached the open exploration of a novel substance with greater curiosity or in a more systematic manner than non-GALAXY students.

- More than half of the GALAXY groups were able to organize themselves and to assign themselves different roles while none of the non-GALAXY groups organized themselves for the task.

- About half of the GALAXY groups, but only one of the non-GALAXY groups, systematically tested the properties of the unknown substances, spontaneously making predictions and then revising them based upon testing.

These results from case study schools indicate that GALAXY students understood the core concepts of Theme 2 and were better at working in small groups and at systematic testing.

The embedded performance assessment for Theme 2, _Chemical Reactions_, asked GALAXY students to (1) observe an experiment involving chemicals, (2) change the variables in some way, (3) perform the revised experiment and record observations, (4) draw a conclusion based upon the two experiments, and (5) design another experiment using the same chemicals and make a prediction about its results.
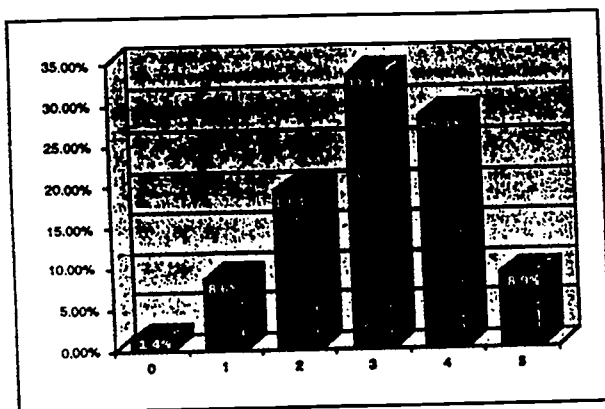
**Figure 4. Percent of GALAXY Students Achieving Competency
on *Chemical Reactions* Tasks**

- As Figure 4 shows, about 71% of the GALAXY students consistently demonstrated on three or more of the five parts of the assessment that they understood the concept of experimentation and could manipulate variables and predict what would. happen.

- It is not surprising that the students had difficulty explicitly stating a cause and effect relationship among the variables (part 4) because of the complexity of the thinking involved.

These results indicate that GALAXY students had developed an implicit understanding of the concepts involved in experimentation, but many were not yet able to reflect upon that understanding and communicate it explicitly to others.

Results for Theme 3: Science is Building Models

The "big idea" presented in Theme 3 involved building and using models to invent and explain ideas. While watching the broadcasts, GALAXY students were challenged to explain surprising phenomena in a "haunted" theater. In addition, GALAXY gave students hands-on practice in the classroom with building and using a variety of models.

The videotaped performance assessment for this theme asked students working in pairs to construct a model from materials provided. The model was to be a device that would solve a specific problem (retrieve a cat stuck in a tree). The results for this assessment show no difference between GALAXY and non-GALAXY students. Possible explanations for this finding include the lack of time spent on this theme because of inclement weather during the winter and a perception by some teachers that a few of the Theme 3 activities were too difficult for their students.

The curriculum-embedded assessment for Theme 3, *Models and Designs*, asked students to use models in three different ways. Students were asked to design a model that was based on the redesign of an existing object (in this case, a bicycle), a model of what was inside a black box (a drinking fountain), and lastly, a model of a tool that could be used to solve a specific problem (unstick a basketball stuck in a net). In each case students were asked to draw a model and to write a description explaining their model. The results show that GALAXY students performed very well on the three tasks of this assessment; the assessment was not given to comparison students.
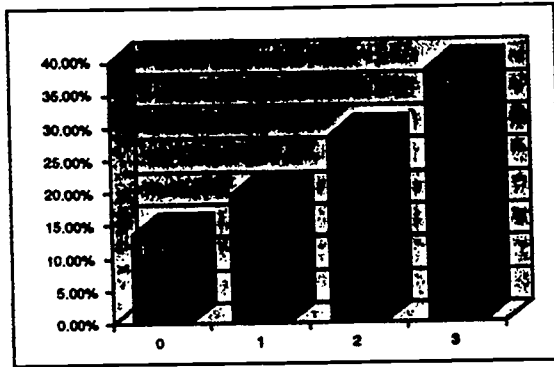
**Figure 5. Percent of GALAXY Students Achieving Competency
on *Models and Designs* Tasks**

- For GALAXY students at all grade levels, the percentage of students demonstrating competence or above were 65.3%, 88.3%, and 87.9% respectively for the three tasks.

- Figure 5 gives the distribution of competency among GALAXY students who participated in *Models and Designs* and shows that, under fairly stringent criteria, two-thirds of the GALAXY students across all grades achieved competency on two or more of three tasks, and 39% could display competency on all three tasks.

Although each task tested a different aspect of using models, the evidence from this assessment suggests that students displayed competence at using models generally.

Culminating Embedded Assessment: *A Mystery*

A Mystery, the final embedded assessment, was given to both GALAXY and comparison students after GALAXY science was completed. It was intended to evaluate the ways that students reason about and investigate the possible causes of unexplained phenomena (strange noises being emitted from an abandoned house). Students were asked to choose among three possible explanations for the cause of the noise — a ghost, people playing tricks, or the wind. "Wind" and "people" were considered appropriate responses; "ghost" indicated that the student might still rely on magical explanations. In addition, students were asked to describe what they could do to determine if their explanation was correct.
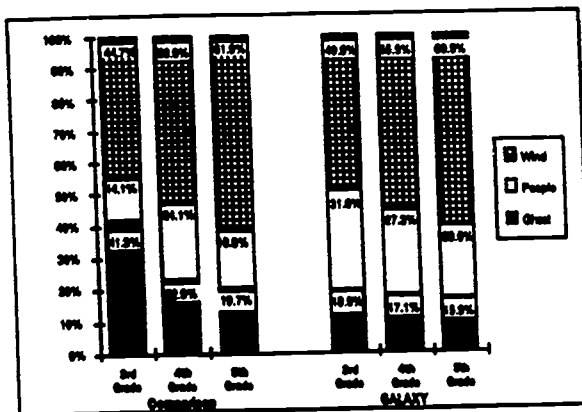
**Figure 6. Percentage of Students Choosing Each Explanation for Task 1 of
A Mystery by Grade for All GALAXY and Comparison**

- As Figure 6 shows, GALAXY students more consistently chose "the wind" or "people" over "ghosts" as a plausible explanation for the noises than did their non-GALAXY peers.

- Significantly more GALAXY students (29.4%) chose experimental approaches for determining the real cause of the noise over simple observation or explanation than did comparison students (20.3%), as Figure 7 shows.

On both parts of this assessment, GALAXY students outperformed their comparison peers at levels that are statistically significant. These results indicate that GALAXY science was successful in achieving its goal of reducing magical thinking (fewer GALAXY students chose "ghost") and increasing understanding of experimentation (more GALAXY students chose active or inactive testing).
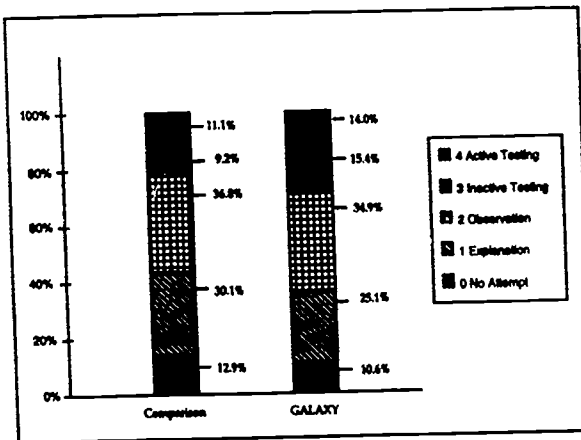
Figure 7. Scores of Matched GALAXY and Comparison Students on Task 2 of A Mystery

Summary of Embedded Assessments

The special videotaped performance assessments and performance-based embedded assessments proved to be useful vehicles for evaluating the extent to which GALAXY students understood the core science concepts presented in each of the themes. Though there did appear to be some age-related differences in understanding these concepts, *the majority of GALAXY students across all grades demonstrated that they understood these "big ideas" and often were able to apply them in new contexts. Further, when non-GALAXY comparison students were evaluated on two of the four assessments, GALAXY students outperformed them in almost every aspect.*

The philosophy of GALAXY Classroom Science has been expressed as "science is the investigation of phenomena by exploring about, asking questions, inventing ideas, and loving it!" Teachers and students who participated in the demonstration phase of GALAXY science spanned a continuum from being uncertain about whether they liked science to being strong supporters of hands-on science. Evaluators were interested in what changes in attitudes among both teachers and students might be produced by participation in GALAXY science.

Teacher Attitudes

FWL researchers surveyed teachers' attitudes towards teaching science both before and after they taught GALAXY Classroom Science for Grades 3-5. Ratings ranged from 1 (strongly disagree) to 5 (strongly agree) on items such as comfort in teaching science, hands-on exploration by students, and availability of appropriate materials.

The scores of GALAXY teachers on the pre-GALAXY survey were quite high, indicating that they already supported hands-on science and were fairly confident about their ability to teach it. For example, teachers very strongly agreed (4.5 out of 5) that elementary students should participate in hands-on science and that boys and girls were both interested in science.

Given these initially high levels of appropriate attitudes and practices, it was somewhat surprising to find statistically significant changes among GALAXY teachers in a number of key areas (5 out of 24 attitude items and 3 out of 9 teaching practices). Teachers moved from comfortable to very comfortable about teaching science (from a mean of 3.79 to 4.52, p<.001) and from calling their materials slightly inadequate (2.78) to quite adequate (4.12, p<.001). They also indicated that they were better prepared to teach science (3.26 to 4.15, p<.001). They even reported an increase in favorable parent comment about students enjoying science (3.29 to 3.86). Statistically significant gains also were reported in the frequency with which GALAXY teachers encouraged students to write about science, used science to teach math, and had hands-on science activities in class. In addition, the reported frequency of science teaching increased.

When teachers were asked on the end-of-year survey how GALAXY had affected their teaching, a number of them gave responses that indicated that their teaching, not just their science teaching, had been permanently changed:

> *"It's changed my philosophy and how I plan for teaching both in terms of goals and how I interact in class: asking questions, probing for better answers, striving for excellence."*
> — GALAXY teacher from Texas

> *"I will never be textbook bound again; even in third grade, children still need the hands-on experience to explore concepts before higher level thinking can consistently occur."*
> — GALAXY teacher from South Carolina

> *"I have done a better job at accepting all ideas and seeing how some strange comments do fit. I have done a 100% better job teaching science. I have lost some of my fears about experiments. I have tried more group projects in other subject areas."*
> — GALAXY teacher from Colorado

> *"[As a result of GALAXY,] I've also changed to using more cooperative activities throughout the curriculum (math, social studies, etc.). I feel this has made me a more effective teacher, and my kids are having fun."*
> — GALAXY teacher from California

> *"GALAXY has shown me that my role in the classroom should be more as 'facilitator' and less as 'lecturer.' I have also learned how much more children enjoy learning when it is learner-driven and they have control over what they learn and how they learn it."*
> — GALAXY teacher from Maryland

Participation in GALAXY Classroom Science facilitated a very positive set of outcomes among the teachers. Hands-on science requires an extra commitment of both time and intellectual engagement by teachers, factors that may deter many from doing it. The evaluation data indicates that being a part of the GALAXY Classroom overcame these impediments and brought exciting science teaching into the lives of teachers and students throughout the country.

Student Attitudes

FWL evaluators developed a 27-item survey to measure student attitudes to science and administered it to both GALAXY and comparison students before and after GALAXY Classroom Science. As part of the analysis, the 27 attitude items were clustered into groups based on their intercorrelations and a cluster score was computed.

There was empirical evidence for four clusters of items, and each was given a descriptive name for convenience of reference: "fun," "learning," "mystique," and "world" clusters. The changes associated with these four clusters are shown in Figure 8.
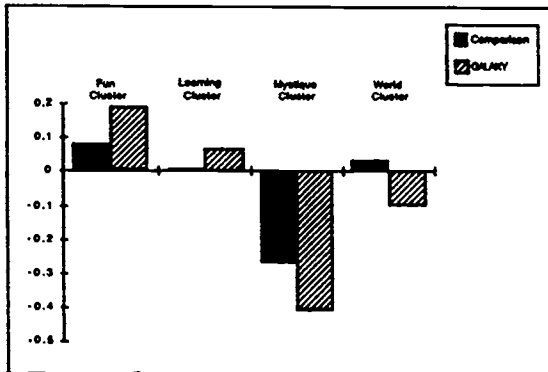
Figure 8. Mean Attitude Change by Cluster for GALAXY and Comparison Students

For a group of nine items, labeled the "fun cluster," GALAXY students had a more positive attitude than comparison students towards how much fun science was at the pre-test, and that gap widened significantly by the time of the post-test (see Figure 8). GALAXY students showed a statistically significant improvement in their perspective on five out of nine items related to doing science at school, whereas comparison students only had such changes on two items. *This evidence suggests that participating in GALAXY Classroom Science positively changes student attitudes about science class.*

Another cluster was a "learning" cluster consisting of four items. Overall, the "learning" cluster score started with GALAXY students significantly more positive and ended with the gap even larger, but the difference between the two groups in the amount of increase was not statistically significant. At the post-test, GALAXY students had higher mean scores than the comparison students by .10 to .13 for all four individual items, a consistent and substantial margin. The evidence from this cluster suggests that participating in GALAXY science classes had a beneficial effect on students' attitudes to engaging in activities in class and not being afraid to make mistakes. GALAXY students are not afraid to "mess around," one of GALAXY's goals.

Five more items comprise a cluster that relates to the "mystique" of science. The changes on the "mystique" cluster score and on the negatively-phrased items in this cluster indicate that science had lost much of its mystique for both GALAXY and comparison students, with a significantly greater decrease for GALAXY students. All of the significant differences for this cluster of attitude items favor GALAXY over comparison students.

The fourth cluster, the "world" cluster, is composed of nine items that generally relate to the relationship between science and the world outside school. This cluster provides some counterpoint to the strongly favora... results from the other three clusters of student attitudes. For these items, GALAXY students not only do not have more positive attitudes than the comparison students at post-test, their decrease in agreement is significant and significantly greater than the change for comparison students (who actually improved slightly). The main exception is an item that said "Science teaches us to try out new ideas," on which GALAXY students increased their agreement markedly more than comparison students, to extraordinarily high levels.

The evidence from this "world" cluster is unexpected and suggests that GALAXY students are having difficulty making the connection between the fun things they do in science class and the way science is used in the real world. Perhaps the GALAXY Classroom Science curriculum needs to be strengthened in areas making the link between the classroom and the larger society.

The results of the student attitude survey confirm that *participation in GALAXY Classroom Science positively affected the attitudes of students towards participating in science class,*

engaging in activities in which they did not know the right answer, and feeling comfortable with GALAXY-promoted learning strategies. But the attitude survey results also suggest that the connection between what was happening in the classroom and the larger world might have eluded them. This is an area that can be added to the curriculum, now that GALAXY has been successful in getting students to like science class.

> "I have been absolutely thrilled with this science program. It has been an incredible experience to watch my children become 'scientists' in the classroom. I have not used any program as well-integrated or as motivating to all my students as the GALAXY science program."
> — GALAXY teacher from Oregon

One of GALAXY's primary objectives has been to get students and teachers excited about science and to motivate them to jump in, begin exploring, keep asking questions, and have fun. As the evaluation evidence from both teachers and students indicates, GALAXY Classroom Science is a highly successful initiative.

GALAXY's broadcasts motivate student interest and provide a realistic context for the hands-on science activities. The thematic structure of the curriculum helps to integrate a wide variety of experiences: participating in hands-on inquiry, writing and communicating through the fax, and doing take-home activities. The teacher institutes and ongoing teacher support have assisted teachers in weaving these elements together.

Although teachers are still learning how to use GALAXY science optimally in their classrooms, the evaluation results point to positive experiences in most classrooms: science is being taught regularly, students are excitedly engaged in hands-on activities, and teachers are developing a new enthusiasm for science and science teaching.

The preceding sections of this report describe the effects on students and teachers of the various curricular, technological, and staff development components of GALAXY science in schools throughout the country. As this report indicates, it is certainly the case with GALAXY science that the whole is greater than the sum of its parts. The components by themselves represent exemplary efforts in science education. Together, they create a powerful package.

EXECUTIVE SUMMARY

I. INTRODUCTION

The first implementation of Galaxy's Language Arts Program was enthusiastically received by teachers and students throughout the nation, and it began to demonstrate a powerful ability to change the character of language arts education, and to raise test scores.

Galaxy appears to be successful in infusing new curricula and bringing meaning-centered instruction to varied settings (urban, rural) and to diverse populations (African-American, Spanish-speaking, Chapter 1). The vast majority of teachers, regardless of teaching style or philosophy, was able to use the curriculum in the way it was intended.

> "You can be smart, but it [Galaxy] can help you get smarter"
> —a Galaxy student from Orangeburg, SC

The Galaxy Classroom Project was developed as a nationwide reform effort to infuse new curricula into schools, to spark the interest of teachers and students in learning, and to make a significant difference in the educational lives of students who traditionally have been labeled "at-risk."

This document describes the findings from an evaluation of the demonstration phase of the language arts cycle for grades three through five, the first curricular area on which Galaxy focused. This evaluation report documents some of the changes, large and small, that took place in Galaxy Classrooms throughout the country.

The Implementation of Galaxy

Galaxy was designed to make a challenging curriculum and learning experience available to all students, including those who ordinarily lack such access. During the demonstration phase, Galaxy is testing its ability to reach America's most economically disadvantaged learners, who typically rank in the bottom third of the nation in educational performance and who slip even further behind as they move through school. The schools selected for the demonstration phase spanned the nation.

What was the Galaxy Language Arts Demonstration Program?
Galaxy is a package of integrated curricular and instructional approaches. It features the organization of instruction around themes, presented through television broadcasts, children's literature, classroom activities, and the use of interactive technology.

During the Galaxy Classroom Project demonstration phase for language arts in grades three through five, classrooms in 37 schools were connected by an interactive satellite communications network. The demonstration took place during fourteen weeks in the spring of 1993. Each classroom was equipped with a fax machine, audioconferencing telephone (the "hoot 'n holler"), video cassette recorder (VCR), and television (TV), which were linked by Very Small Aperture Terminals (VSATs) to enable two-way voice and data communication and one-way television communication.

Each classroom utilized a core of six literature books per theme, a take-home magazine, a teacher's guide with suggestions on reading and writing strategies, and a wide choice of classroom activities for before, between, and after the broadcasts for each theme.

The television broadcasts dramatized the Galaxy themes through a continuing drama about the lives of a multicultural group of students, interacting together in an after-school community center. The story line was engaging and featured characters with whom students could identify. The open-ended themes in the programs were intended to stimulate critical thinking and discussion, unlike the traditional use of "instructional" television.

Galaxy's literature was carefully selected to complement the themes and to engage its multicultural audience of learners; these books contrast significantly with traditional "basal" readers. The array of learning activities was rich—about 20 activities for each theme. They encouraged group, individual, and whole class instruction; involved discussion, writing, drawing, and other instructional modalities; and presented teachers with choices, while still maintaining a clear focus on the integrating themes of Galaxy.

The Evaluation Approach

The Far West Laboratory for Educational Research and Development carried out a multifaceted evaluation of the operation and impact of the program for this initial demonstration phase.

The evaluation encompassed testing of student learning through both standardized measures and performance-based instruments, surveys of teacher and student attitudes and teacher practices, and teacher records of utilization of the Galaxy curriculum. Specialists from the Educational Testing Service assisted in the development and scoring of writing performance measures.

Measures of student learning were administered in two kinds of comparison classrooms, classrooms which were not using the program in Galaxy schools and others in demographically similar schools where Galaxy was not being implemented. In addition, repeated observations and interviews were carried out in five case study schools throughout the country, with shorter visits to several other schools. Those case study classrooms

ranged from a rural community in South Carolina to inner-city schools in Washington, D.C., and Oakland, to largely Hispanic schools in Los Angeles and New York City.

The Final Report analyzes the impact of Galaxy during this period. It also reviews the operation and impact of each component of the Galaxy system.

II. THE EFFICACY OF THE CURRICULUM STRUC- TURE: THE THEMATIC CURRICULUM

The intellectual core of the Galaxy curriculum was the organization of all instruction around seven successive themes, each of them designed to be of genuine concern to Galaxy students. They included issues such as fairness, the complexities of maintaining personal privacy, and "people are more than they appear to be." The success of this thematic structure was essential to the success of Galaxy, both for motivational reasons and for providing a coherent, integrated structure for the diverse Galaxy activities.

The specific goals of Galaxy's thematic structure were to: provide the context for real life reading and writing activities; provide students with opportunities to relate the ideas embedded in the themes to their own lives and experiences; and engage and motivate students in learning.

Teacher and Student Responses

The evaluation assessed the efficacy of the thematic structure through survey questions of all Galaxy teachers at the end of the year, observations throughout the course of instruction in selected schools, and interviews with teachers and students. All evidence supports the view that this crucial element of Galaxy was extraordinarily successful.

- Teachers frequently described the seven themes that formed the core of the Galaxy language arts curriculum as "powerful," "motivating," and "relevant."

- Over 90% of the teachers who responded to an end of year survey thought that the Galaxy themes had great educational value, and nearly the same fraction reported that students liked the themes "a lot."

- Students remembered the Galaxy themes, even at the end of the semester.

- Students understood the themes and could relate them to their own lives and to the Galaxy literature.

III. READING AND WRITING OUTCOMES

The evaluation assessed student reading and writing abilities and attitudes, as well as changes in teacher attitudes and teaching practices.

Reading

Galaxy provided numerous opportunities to encourage student reading, not as an academic exercise but as a purposeful and satisfying activity. Galaxy reading activities involved both reading aloud and individual reading of an array of materials: the Galaxy literature books, a student magazine designed to be taken home, faxes received from other students and from Galaxy, and the work of classmates resulting from a rich array of small group activities. The Galaxy books dealt with engaging subjects and characters with whom it is easy for Galaxy students to identify. Listening to the reading of good books provided a common basis for the sharing of perceptions and personal meaning. Within the broadcasts, the characters modeled children communicating purposively through reading and writing. The reading of faxes from afar provided a connection with the writing of real human beings.

Galaxy delineated several goals for students as a result of participation. Students should be able to: read more; read for pleasure; acquire meaning from context; relate reading material to their own background knowledge; and enhance their reading abilities.

The evaluation has found very positive outcomes in this area.

Teacher and Student Response to the Reading Component

There is little doubt that the character of reading activities was markedly transformed by the Galaxy experience, particularly for classes that had previously been using basal readers as the focal point for reading and language arts instruction. The ability to discuss and think about reading activities within a thematic framework was tremendously appreciated by teachers, while both teachers and students reported great enthusiasm for the content of the books and for the receipt of faxes from afar.

The following teacher comments typify their reactions:

> "This program gets a Rave Review from me. I loved the ... wonderful books. But, watching my students loving to read and write more was extremely rewarding."

> "The students love to hear me orally read the new Galaxy books for each theme, which motivates them to want to read the books."

The Impact of Galaxy on Overall Reading Achievement

The evidence shows that Galaxy participants achieved significant gains in reading achievement. Participation in Galaxy had a clear benefit for students' reading, as measured by standardized test scores for two components of reading assessment, vocabulary and reading comprehension. These results are based on testing 2,826 students in 146 classrooms in January and May, 1993, using the vocabulary and reading comprehension subtests of the California Achievement Test, Fifth Edition (CAT/5). While children in comparison classrooms tended to drop relative to their peers on national norms, as is typically the case with economically disadvantaged children, a greater percentage of Galaxy children held their own, providing them with a stronger base for further growth. For example:

- Galaxy students significantly outperformed comparable students in reading achievement on the CAT/5 in both vocabulary and reading comprehension.

- These gains are similar for grades 3, 4, and 5, regardless of gender, ethnicity, Chapter 1 eligibility, home language, and special education status.

- Gains are similar regardless of how well students initially performed on these measures.

Vocabulary Achievement Results

The results for the vocabulary subtest showed that participating in Galaxy produced significant gains.

- Vocabulary gains showed a statistically significant difference in gain between Galaxy and comparison students. As Figure 1 shows, Galaxy students had an average gain of 13.8 scale score points, while comparison students gained an average of 10.05—a 37% greater gain for Galaxy students. Galaxy students performed above expectation suggested by national norms by more than 30%.

**Figure 1. CAT/5 Vocabulary Gain
January-May 1993, Chapter 1 Schools**
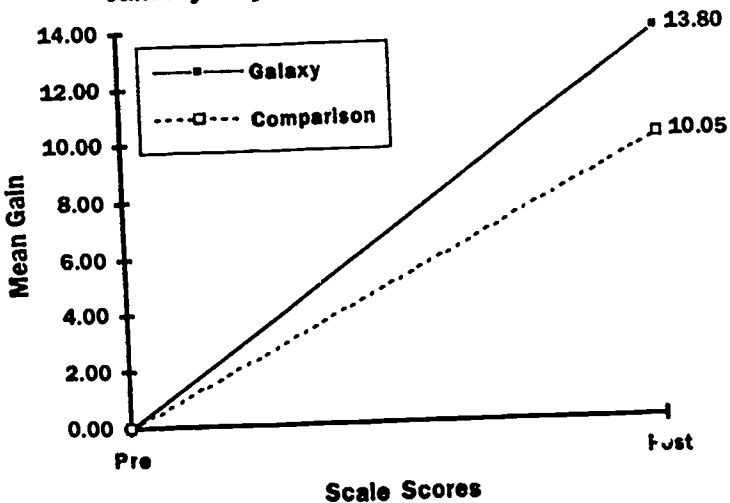
- When Galaxy and comparison classrooms are matched by rank from highest to lowest in terms of gain, Galaxy classrooms display consistently higher gains on vocabulary scores.

- Seventeen percent of Galaxy classrooms made average gains on the vocabulary subtest that were twice as great as expected (scale score gain of 20 points or more). In other words, in seventeen weeks of school these classes gained as much as is typically expected for a full school year, whereas only nine percent the comparison classrooms made similar gains.

- Galaxy Chapter 1 students performed better when compared to national norms for the vocabulary subtest than is typical for Chapter 1 students.

Reading Comprehension Achievement Results

Participation in Galaxy also conferred a comparative advantage on the reading comprehension subtest.

- The reading comprehension subtest showed a statistically significant difference in gain between Galaxy and comparison students.

- As Figure 2 shows, Galaxy students had an average gain of 7.67 scale score points, whereas comparison students had an average gain of 3.13 points.

Figure 2. CAT/5 Reading Comprehension Gain January-May 1993, Chapter 1 Schools
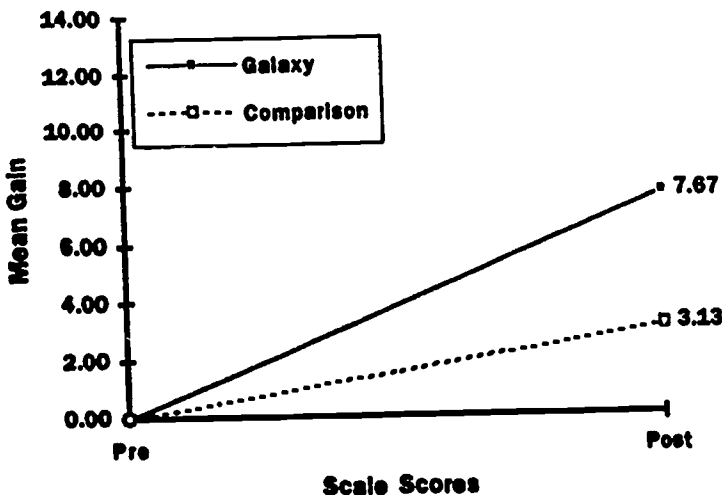
- These data show that Galaxy students made 145% greater gains than comparison students in reading comprehension.

- When Galaxy and comparison classrooms are matched by rank from highest to lowest in terms of reading comprehension gain, Galaxy classrooms display higher gains at almost every point.

The Intensity of Teaching Galaxy and Reading Gains

The more fully Galaxy was taught, the greater were the reading score gains. In classrooms where teachers spent more time teaching Galaxy, where it became the central core of their language arts curriculum, and where they used the fax capability more than other teachers, student performance gains were substantially higher in vocabulary. In fact, students in such classrooms actually gained in percentile rank.

- Students in classrooms whose teachers used Galaxy as a replacement for their traditional language arts curriculum scored two-thirds better on the vocabulary subtest (mean vocabulary gain of 21.1) than students in classrooms where Galaxy was a supplement (mean vocabulary gain of 12.5). Figure 3 compares the vocabulary scores from these 10 replacement classrooms with the 79 other Galaxy classrooms. Both groups scored better than comparison students.

Figure 3. Vocabulary Gain for Supplement/Replacement

Figure 3. Vocabulary Gain for Supplement/Replacement
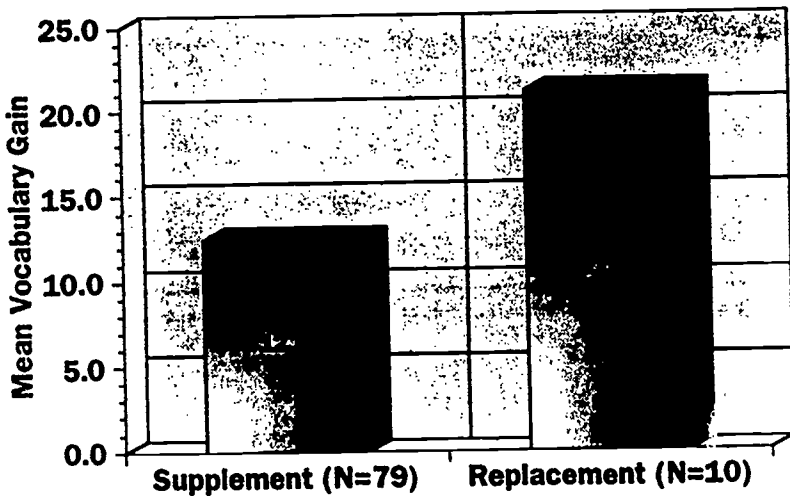
- Time spent on teaching Galaxy is significantly correlated with reading gains. Classrooms that ranked in the upper 25% in terms of time spent teaching Galaxy had gains that were 80% higher in vocabulary and one-third higher in reading comprehension than classrooms that ranked in the bottom 25% of time spent on Galaxy. The data for vocabulary scale score gains are shown in Figure 4.

Figure 4. Vocabulary Gain by Time Teaching Galaxy
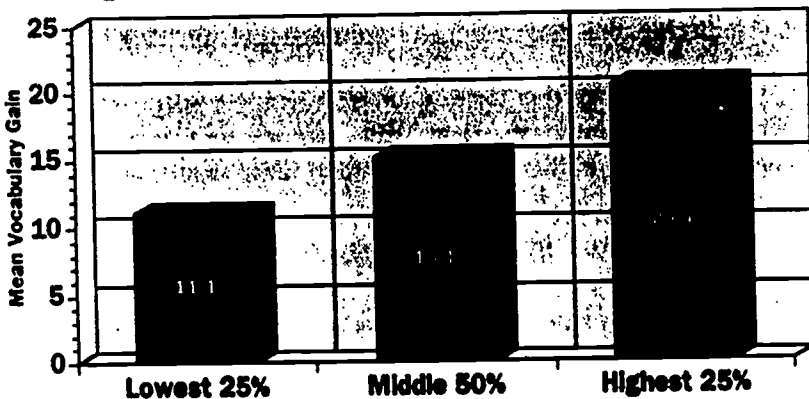
- Average gains in classrooms where the fax machine was used two or three times per week (as recommended by Galaxy) were twice as high as for occasional use class-

84

rooms on reading comprehension (11.0 versus 4.0) and almost 75% higher on vocabulary (16.1 versus 9.3). Figure 5 displays the vocabulary scale score gains.

Figure 5. Vocabulary Gain by Frequency of Fax Machine Use
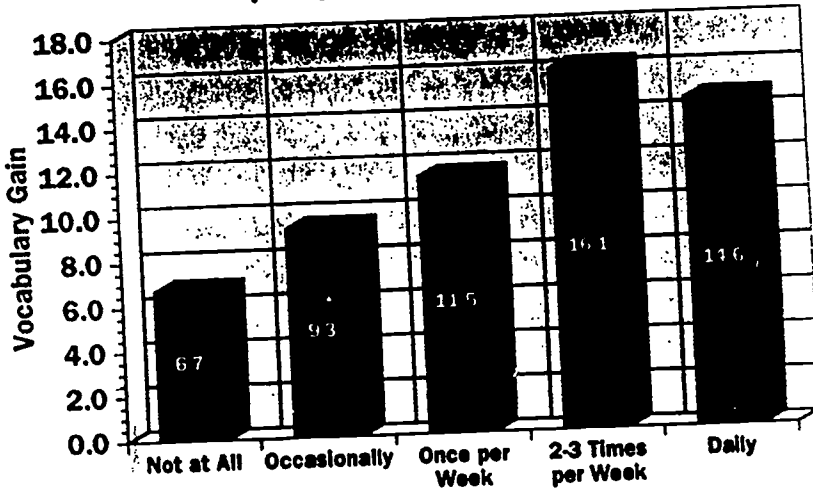
Writing

Galaxy provided a unique context to stimulate student writing through writing and faxing to real audiences and by writing about themes that clearly had engaged student interest. The specific goals of the writing component were to encourage learners to: write for real purposes; be able to think about what they were writing; relate their writing to their own lives and to prior experience; write more; and enhance their writing abilities.

The assumption was that writing would become a purposeful part of students' lives rather than mere exercises and that, as writing increased, writing abilities would improve commensurately.

Teacher and Student Responses to Writing

Writing is seldom a popular activity for students. Galaxy seemed to succeed in making writing more interesting and personally relevant for most. For some students, the Galaxy experience produced a breakthrough in their enthusiasm and desire to write.

- Many teachers report that they have changed how they teach writing.

- Teachers notice that Galaxy students, regardless of ability levels, are more willing to undertake writing assignments, and to write on their own. In addition they report a general improvement in the quality of student writing.

- However, teachers report that they were unable to fully implement the process writing approach due to the time constraints of the Galaxy theme cycle. An analysis of student work confirms that few students had experience with the full range of process writing (pre-writing, drafting, revising, editing, publishing).

- Teachers report that Galaxy was successful in enabling students to brainstorm writing ideas and to write for real audiences

- Teachers cite the highly popular broadcasts, which present their students with real problems about which they want to express an opinion; fax machines, which encourage students to write for a real audience; and the Galaxy activities guide as having been instrumental in motivating students to write.

- Galaxy students report that they are writing more than in previous language arts instruction. Students in the case study sites describe their Galaxy writing as being about topics that are important to them in contrast to last year's writing which they describe in terms of book reports, writing stories using spelling words, doing reading skills workbooks, and keeping journals.

Measures of Writing Achievement

The evaluation measured one particular type of writing, persuasive writing, which required students to take a position on an issue and support it with evidence. Pre-post measures of this writing ability, given to both Galaxy and comparison students, used writing prompts that were supplemented with embedded performance tasks for Galaxy students only.

- Both Galaxy and comparison students made statistically significant gains on the pre/post writing prompts, but there was no significant difference in performance between the two groups.

- Galaxy students showed statistically significant gains on the embedded performance assessments one through three, but there was no significant gain when all four performance tasks were viewed together. However, performance assessment four was administered very close to the end of the school year, and student scores may well have reflected various distractions in the school environment. The pattern of gain was similar for Galaxy students in each of the three grades.

- It is probable that Galaxy writing outcomes will be enhanced as teachers learn to include more "process writing," the process of review and revision that is designed to develop writing skills.

IV. THE ROLE OF INTERACTIVE TECHNOLOGIES IN GALAXY

One of Galaxy's unique advantages is the ability to engage students in interaction through its dedicated satellite network, classroom fax machines, and "hoot 'n holler" audioconferencing network. The fax, in particular, is integral to the motivational incentives of Galaxy's approach to language learning.

The specific goals of Galaxy's interactive technologies were to: bring the world to the classroom and the classroom to the world; facilitate writing for real purposes; foster a "community of learners" among Galaxy teachers and students across the country; and expose students to technologies with which they may not otherwise come in contact.

General Observations Regarding Interactive Technologies in Galaxy Classrooms

When the fax component of Galaxy worked well, the evidence shows that it was highly successful in motivating students. Test scores, as noted earlier, were particularly high in those class-

rooms with frequent fax usage, and student and teacher reports were enthusiastic. However, there were a number of technical problems: installation was delayed in several schools; the scheduling of fax transmissions proved frustrating for some; and the lack of response to faxes sent was a disappointment, compounded by a system that did not confirm successful transmission of faxes. There was not a specific goal for the "hoot 'n holler" system, and therefore it was little used.

Overall, Galaxy's assumptions about the unique power of the fax to engage students in writing and reading activities was demonstrated to be eminently correct. The evaluation findings support efforts to improve its operation to make it easily available to all classrooms.

- Frequent use of the fax machine was associated with higher gains on the vocabulary achievement subtest.

- There were technical problems with the new fax network.

- The use of the fax machines proved frustrating for some teachers because of unreliability or difficulties in operation and lack of confirmation of successful sending or receiving.

Teacher And Student Responses

For many of the Galaxy students, the use of the fax machines served as a powerful motivator to write for a real purpose.

- Problems with technical operation and reliability hampered some classrooms' use of the fax machine.

- The majority of classrooms that reported usage used the fax machine two or more times per week.

- Over 85% of teachers who responded to an end of year survey reported that their students liked faxing a lot.

- Teachers rated their students as most enthusiastic about faxing to THE HOUSE and seeing their faxes on subsequent broadcasts

- Students were proud of their new-found ability to com-
  municate across the country with other students via fax.

- The use of the fax clearly did inspire students to write for
  real purposes

V. THE EFFECTIVENESS OF GALAXY'S PROGRAM COMPONENTS

The evaluation analyzed students' and teachers' receptiveness
to and utility of each of the Galaxy components.

**The key components of the Galaxy curriculum received ex-
tremely high marks from participating teachers and students.**
Survey results show the highest possible ratings for the educa-
tional value of the literature, the broadcasts, the activities, and
the in-service training institutes; 90% of teachers who re-
sponded to an end of year survey typically rated each of these
as having "high" educational value. In addition to their indi-
vidual quality, these components worked together well as an
instructional system that teachers could embrace and utilize in
their classrooms.

Broadcasts

Two-week theme cycles began with a 15-minute television
program (the A show, broadcast in English, in Spanish, and with
closed captions) that explored a theme such as "fairness" from
multiple perspectives and posed issues for the students to
consider. The broadcast at the end of each cycle (the B show)
incorporated selected student fax responses to these issues.
There were fourteen such broadcasts during Galaxy language
arts. Since it was possible for teachers to tape the broadcasts,
they c ld use them repeatedly throughout a theme cycle.

The goals of the broadcast component were to: introduce and
create interest in the language arts themes; connect them with
the real world of the students; and stimulate writing for real
purposes

Teacher and Student Responses

Interviews and survey results show a very strong endorsement for the educational value of the broadcasts and their ability to engage students.

- The broadcasts resonate well with students, and they are a powerful way of capturing students' attention.

- The Galaxy broadcasts were a hit with teachers as well; they were nearly unanimous in the high praise they awarded to the broadcasts.

- Teachers report that the characters and storyline were compelling and engaging for all students, regardless of gender, ethnicity, or geography. The primary limitation of the broadcasts were the short broadcast time period (two days for each show) and the short time period between the A and B shows.

- The programs were shown repeatedly on videotape in most classrooms. Sometimes they were shown in their entirety, while in other cases teachers stopped the tape to encourage discussion of themes within the broadcast or used a segment just before a related learning activity.

- All but one of the eighty-one students interviewed gave the broadcasts the highest possible rating.

Student Activities And Teacher Resource Materials

The goal of these materials was to facilitate the use of many different resources at varying degrees of difficulty so that all students regardless of ability could participate.

Teacher reflections

The evaluation found that teachers used the various suggested activities extensively and rated them highly as educational tools.

- Teachers selected activities that incorporated a variety of instructional modalities (e.g., art, drama and role play, listening, writing, reading).

- Galaxy activities met the educational needs of students of varying ability levels.

- Over 90% of the teachers who answered the end of year survey found the Galaxy activities to be "very useful" for their teaching.

- Teachers report that they were able to adapt and modify the Galaxy activities to fit their own particular teaching style and interests. Therefore, it appears that most classrooms received tailor-made Galaxy instruction.

Small Group Instruction

Many suggested Galaxy activities centered around small group instruction. Its goals were to allow each student to participate in Galaxy activities fully and to facilitate students' learning from one another

Teacher and Student Responses

Many teachers found that cooperative groups worked well for their students. However, some teachers, largely those who had not used small group instruction before, experienced problems. The latter found that small group work diverted their energies from instruction to classroom management issues.

Illustrative of teacher attitudes toward the small group activities are the following comments:

"...the cooperative learning groups worked well, and I plan to give my students many opportunities to share ideas orally in groups and for the whole class next year to develop some of the necessary skills to become good readers and writers."

"Galaxy helped the students work cooperatively which gave me time to focus on those students who were having special prob-

lems. Language Arts took on a whole new meaning and look. Awesome!!"

Some students who were interviewed singled out the group experiences as "the most important thing they had learned from Galaxy."

"Learning is fun and it's not boring. I learned how to work in groups and cooperate and take turns, that's all. And I learned how to write stories."

"I learned how to work in groups. I used to not like working in groups. They kind of slow me down. Now I learned to get some of their ideas."

Galaxy Literature

Children's literature was a central focus of the Galaxy program. The Galaxy literature was carefully selected to relate to the seven Galaxy themes, while providing a choice for differing levels of difficulty and for personal teacher preferences. During the Galaxy demonstration, six books of the teacher's choice were provided for each theme—42 for the semester. Since the number available was limited, teachers were encouraged to read books aloud in class, a widely recommended instructional strategy, as well as to encourage individual reading.

The objective was to enhance self-esteem and develop literacy by helping students understand and debate opposing viewpoints, express their personal strengths, and collaborate with others to delve into the meanings of literary works—and how those works might relate to their lives.

The specific goals for the literature were to: bring high quality children's literature into the classroom; integrate the Galaxy themes and children's literature; and engage students in reading, thinking about, and discussing the themes that underlie the curriculum.

Teacher reflections

- Most teachers thought that the Galaxy literature books had great educational value and that their students liked

them a lot. Teachers greatly appreciated the books and referred frequently to their high quality and relatedness to the themes.

- Teachers were successful in linking the books to the Galaxy themes, mainly via the Galaxy activities.
- A few teachers requested higher level books for 5th graders.

Student Comments

The Galaxy literature resonated well with the third through fifth grade students. Students at the case study schools rated the Galaxy books very highly; they clearly enjoyed reading them. A few, however, were somewhat critical of their teacher's read-aloud style. Students were able to remember all of the Galaxy themes at the end of the cycle and to connect them to the literature. For example, the following statements were offered by case study students when asked about their favorite books:

Big Orange Splot: "Because Mr. Plumbean was different from the others, he was true to himself and did not let others bug him. He was brave and he was a leader. He encouraged people to follow their dreams." (Theme 4: Be True to Yourself)

Big Al: "At first he seemed ugly and mean—but they just couldn't see the other side of him—his inside was nice." (Theme 1: People are more than they appear to be)

In addition, students connected the literature to their own lives:

Angel Child, Dragon Child: "I like to learn about history and things about different races. I like to read books about prejudice because I'm into peace and I like to find new ways to help make peace."

The Pain and the Great One: "I have a brother. He's little and I'm big. He gets treated differently. It helps you think of things you can do with a brother."

Teacher Support

Galaxy's staff development component, particularly two in-service training institutes that brought together all Galaxy teachers and principals for several days, was significant to Galaxy in many ways: in introducing the curriculum and its many integrated features, in providing hands-on experience with the fax and other technologies, and in developing a sense of community relationship throughout the Galaxy network.

Its goals were to: familiarize teachers with meaning-centered instruction, process writing, and literacy strategies; introduce teachers to the Galaxy curriculum and teaching philosophies; acquaint teachers with the seven Galaxy language arts themes; and familiarize teachers with Galaxy technology and how to use it.

Teacher comments

- The vast majority of teachers thought that the workshops and presentations at the two teacher Institutes contributed greatly to their ability to teach Galaxy language arts.

- Many teachers would have appreciated more on-going support during the cycle both for substantive issues and for the various technologies.

VI. CONCLUSIONS

In summary, the first phase of the Galaxy demonstration achieved a number of unequivocal successes. It brought to a cross-section of America's economically disadvantaged students a classroom experience that connects reading and writing to their own concerns, knowledge, and experiences, and that respects their substantial intellectual capabilities. Galaxy reached its diverse multicultural learners in a way that gener-ated extraordinary student enthusiasm. That enthusiasm was shared by teachers, who in numerous cases reported that the experience had brought new life to their professional work. Galaxy has had an impact beyond language arts; it has changed the way many teachers view the capabilities of their students.

Galaxy's unique interactive component, the use of the fax machine, fueled that enthusiasm, despite technical problems.

The changes that Galaxy generated have begun to have a positive impact on student learning; Galaxy students gained appreciably more both in vocabulary and reading comprehension measures than did students in comparable classrooms. As experience develops further in subsequent iterations of Galaxy, further impact should be seen; Galaxy's networked community of learners and teachers provides a splendid opportunity for its continued evolution.

STATEMENT OF CAROLYN REID-WALLACE, SENIOR VICE PRESIDENT, EDUCATION, CORPORATION FOR PUBLIC BROADCASTING

Senator COCHRAN. Ms. Joy Rouse, let us go to you next. I understand you are going to talk about Chapter 2.

I am sorry. Dr. Carolyn Reid-Wallace is next.

Dr. REID-WALLACE. Mr. Chairman, I am going to remove myself from this obstructed view.

Senator COCHRAN. Yes; we want you to go sit by Mr. Vance, if you would. That way we will see you better.

Dr. Carolyn Reid-Wallace is senior Vice President, Education, Corporation for Public Broadcasting, here in Washington.

We are very glad you are with us this morning.

Dr. REID-WALLACE. Thank you very much, Mr. Chairman.

I would like to note that my written testimony is here, and will be presented to you for your consideration. I am going to keep my remarks very brief. They will attempt to summarize as clearly and as quickly as possible the substance of these written remarks.

No. 1, I want to begin by thanking you, Mr. Chairman, for your vision, your dedication, your commitment to what I would characterize as the littlest citizen in America. The youngster who is 2, 3, 4, or 5 years old cannot vote, does not have a large bank account, but certainly represents the future of this Nation.

And the fact that you and your colleagues have a vision of courage and the tenacity to advocate on behalf of America's littlest citizens suggests to me and to my colleagues, not only at the Corporation for Public Broadcasting, but across this country, that there really is hope for this country.

And I have come to say to you this morning that the Ready to Learn Program that you have already heard Secretary Kunin and her colleagues speak about is a critically important program.

Oh, I know that everyone says that every program is critically important. But in this case, it really is important, because if our children, who will, we hope, become our future leaders, have any possible hope of becoming literate, of becoming full of the intellectual capacity that their parents dream that they will possess, they have to do it early enough to allow them to move into the first ranks, not only of scholarship, but of thinking. And Ready to Learn proposes to do just that.

What is it? It is simply a way of using a fairly accessible technology, television, as a means of helping little children begin school ready to learn.

They are taught their colors. They are taught to think. They are taught some values. And, indeed, by the time they reach first grade, we hope that they have acquired the requisite skills.

We think this is terribly important, not only because this Nation must take a quantum leap, and extend to 15 years, in terms of global competitiveness, but also because we believe that Ready to Learn and the component parts of this particular program are cost effective, they are universally accessible.

Some 99.5 percent of every household in this Nation has access to the technology that Ready to Learn will use to transmit information.

And finally, we believe that Ready to Learn is critically important, because it says that America does value its youth, because it says that America values the potential of all of its citizens, black and white, Mississippian, and Californian, to learn, and to learn well.

PREPARED STATEMENT

So I thank you for your support, and I would say to you that 100 years from now, when the annals of history are being written and rewritten, the name of Senator Thad Cochran and his colleagues will, in fact, become more than a household name.

You will become a recognized States person on behalf of the future of this Nation. I thank you so very much.

Senator COCHRAN. Thank you very much.

[The statement follows:]

STATEMENT OF CAROLYNN REID-WALLACE

I sit before you this morning as a citizen of this nation who wishes to thank you, Senator Cochran, for the extraordinary role that you have played in advocating on behalf of the littlest citizens of America—the two-year old and the three-year old, who cannot vote, but because of your advocacy have the extraordinary potential to become learned and productive citizens. I sit before you as a person who understands as well as anyone in this room why children--no matter what color, ethnicity, race, or creed--must begin school ready to learn. As a black woman, as a mother, as an educator, as a human being who believes fervently in the power of knowledge to ennoble and to advance a people, I believe absolutely in the need to educate children at this critically young age. I believe in the capacity of technology and the human endeavor to get this job done.

I also know that at the Corporation for Public Broadcasting, I conduct business every day fueled by belief in a continuing educational vision, and that this vision speaks to providing education of the highest quality for all citizens, no matter who they are or where they live. We at CPB have a long history in education, in children's television, in broadcasting designed for children rather than for profit. It is an honor, and a fitting honor, for CPB to work closely with the U.S. Department of Education in the planning and administration of the Ready To Learn Project.

In the last decade or so, research has made clear the vital importance of the years of early childhood; they are the pivotal gateway to many aspects of further development. Children who miss out on key steps in cognitive, affective, and social development during the preschool and early school years are most likely to continue missing--and losing--all the way through school, and perhaps through life. On the other hand, children who in those critical years receive age-appropriate instruction, reinforcement, and attention tend to continue learning and thriving. These are the steps by which all young children become ready to learn. And the use of television can be a primary force in providing this essential instruction and reinforcement. In Ready To Learn: A Mandate For the Nation, Ernest Boyer identifies the importance of television as a significant influencer of children. "Next to parents," he states, "television is a child's most influential teacher." Television carries this influence because, among other factors:

- a six-month-old infant watches one and one-half hours of television per day;
- a five-year-old watches two and one-half hours of television per day;
- by the time a child enters kindergarten, he or she is likely to have spent 4,000 hours in front of a television set;
- all told, the nation's preschoolers watch a total of 14 billion hours of television every year.

The use of such universal and commanding technology toward the education and benefit of children is essential. Television viewing is an active experience that can have positive outcomes, and the context of that viewing is an important determinant on those outcomes. Boyer suggests that, ". . . with selective viewing, television can contribute richly to school readiness. But for this to happen, parents must be well-informed and must guide the viewing habits of their children."

Ready To Learn, then, is a national education program for pre-school and early school children, their parents, and their caregivers--a mighty combination of the best that television, and human beings can marshal for the foundational education of young children; a lively, solid course of study designed to help all children begin school ready to learn, and to continue to experience learning in school positively and enthusiastically. The Ready To Learn Project will increase school readiness in all pre-school and early elementary school-aged children across the United States by undertaking the following:

1. The support and development of educational television programming of the highest quality which will focus on the cognitive and social development of both boys and girls from many different social, cultural, and geographical backgrounds.

2. The support and development of accompanying program-related materials of the highest quality which reflect the soundest educational principles and objectives by which young children learn and develop. This will be accomplished by using the power of television to direct children and their families to books and other learning resources that, in conjunction with television programming, encourage family literacy and intellectual curiosity.

3. The guarantee of universal access to the American citizenry. Programming will be will be closed captioned, and wherever possible include descriptive video. Ancillary materials will be written in direct and clear English and in Spanish, will include activities and techniques possible for all parents and all children, and will be widely disseminated.

The Ready To Learn Project administered by the Corporation for Public Broadcasting will support, over a five year period, the creation and/or dissemination of children's television programming, supplementary educational materials, childcare and parenting expertise, and children's books through the combined efforts of producers, educators, communications entities, publishers, and community organizations. CPB will cast its nets widely, seeking the very best programming and educational materials from among commercial and cable networks, public broadcasting, and independent producers in order to assemble an extraordinarily effective Ready To Learn to educate our children. Through its rigorous and impartial selection process, the Corporation will make grants to effect the following:

Television programming. We know that some television shows being watched by children this morning are programs that teach. Research has demonstrated that thoughtful and carefully constructed programming for children helps them toward greater cognitive and social development, varied approaches to learning, language skills, vocabulary flexibility and fluency, general knowledge, and motor development—factors that make a child ready to learn. The Ready To Learn Project will extend that kind of teaching by funding new programs for children which have this high level educational impact. A recent Carnegie Foundation study indicates that raising the level of parent education may be the single most important factor in helping children achieve school readiness. Ready To Learn will also fund innovative adult programming that presents positive models of parental and adult involvement in the lives of children, and that will provide useful information and tools which adults can use in preparing children to be ready for school. We are taken with the possibility of public broadcasting, commercial networks, and cable companies producing prime-time adult special in concert with one another so that on one night for one hour American broadcasting might focus on parents and children.

Educational materials. Educational materials for children, their parents, and caregivers will be required in order to maximize learning readiness opportunities presented by the programs themselves and to bring full circle the dynamic created by parent, child, the viewing of quality programming, and attention to the language, the written word, books, and reading. Learning guides and other materials ancillary to programming will be developed and tested by early childhood experts; these will reflect sound educational principles, and are designed to help adults extend their children's television learning through home activities which promote continuing intellectual curiosity and family literacy. Workshops led by a local expert--perhaps a local pre-school teacher--and featuring these materials as well as children's books will reinforce and pull together in a powerful and personal way the impact of the televised messages and the printed word in books. Community partnering organizations such as Head Start, Even Start, AARP, Aspira, the Junior League, PTA, and commercial or public television stations will sponsor these workshops across the country.

In the first year, CPB will solicit and select grantees to produce children's programming, an adult prime-time special, an ongoing, bilingual monthly newsletter, and seek permanent partnerships which link children, television, and books through grants to book providers and local libraries. These elements will continue in year two, and proposals for additional children's programming, several longer written education pieces including one on media literacy designed for parents, and national models for community workshops will be solicited and funded. During the third year, educational materials specific to programming funded in year one and airing in year

three will be funded and produced. The fourth and fifth years of the project will focus on the

workshops and the consolidation of all project elements.

Ready To Learn is a high quality national education program which must be accessible to

all of America's children regardless of the economics of their neighborhoods. This is possible in

part because the technology is simple and cost effective, and because the combination of television,

the printed word, and the human teacher is a most powerful one. All children in all American

households, their parents and their caregivers, should receive the benefit of the Ready To Learn

Project.

STATEMENT OF JOY ROUSE, PRESIDENT, BOARD OF EDUCATION, ST. LOUIS COUNTY, MO

Senator COCHRAN. Ms. Joy Rouse, president of the Board of Education of St. Louis County, MO, let us go to you now. We are glad you are here.

Ms. ROUSE. Thank you. I am honored to be here today, and to have the chance to say thank you for your support of innovation in education through chapter 2 funding. I know that school districts nearly lost this source of revenue last year, and I am grateful for your role in preserving that for us.

Both professionally and as a community volunteer, I have seen the positive results of chapter 2. As deputy director of the Parents as Teachers National Center, I have seen Parents as Teachers grow from four pilot projects in Missouri, to over 1,500 programs nationwide, programs which continue to demonstrate positive results for young children and families. chapter 2 has been a funding source for some of these programs.

As president of the Parkway school board, I have seen the innovative programs chapter 2 has allowed us to initiate, and have talked with teachers and children who have benefited. Parkway is a large district in St. Louis County, with a very diverse population of 22,000 students, including 3,000 desegregation students from St. Louis City, and over 3,000 special education students.

We are proud of Parkway; 13 of our 27 schools have received the blue ribbon award from the U.S. Department of Education.

But we also acknowledge that our teachers are facing greater challenges than ever before, and that they have greater competition for the attention and focus of their students.

If these teachers are to meet the competition and motivate reluctant learners, they must access the valuable opportunities technology has to offer. Chapter 2 funds have brought a variety of special technology-based projects to Parkway.

Students now have the chance to explore artistic masterpieces on laser disc, conduct computerized science experiments, interact on CD–ROM's to explore world cultures, and solve complex numerical computations on desk-top computers.

In other words, chapter 2 funding for technology has been used to enhance directly the basic core subjects of math, science, history, literature, and the arts.

Using CD–ROM's seems to hold a special benefit for our students from deprived backgrounds. Take, for example, Adam, a third grader from the inner city who has behavior and learning disabilities.

Recently, Adam's class was developing a research report on animal behavior, and a trip to the zoo was scheduled. Adam overslept that morning and missed his long bus ride out to Parkway, and so missed the field trip.

Yet, because of a portable multimedia center purchased with chapter 2 funds, there was another chance for Adam to be a part of this project. The technology opened up Adam's world and provided him with the tools and motivation to become a researcher, writer, and producer.

Another of the significant opportunities available through chapter 2 funds has been the professional development classes for our teachers. We are entering a whole new world of education.

So we cannot say, just go take another college class, and expect teachers to gain the expertise they need to use technology with students in a purposeful and productive way.

Our goal is to be sure that teachers can and will use the technology to teach our curriculum. Unless this training is given a high priority, the equipment becomes merely a showpiece. This is no small task for a district with a faculty of 1,400.

Chapter 2 is rooted in the perspective that the responsibility for providing outstanding learning opportunities for children belongs to the Nation, just not the local school district.

We all have a stake in the success of our students. Federal support is vital to our sustained effort in this area. School systems everywhere are facing difficult financial times.

Despite carefully designed budgets, districts such as Parkway are being challenged with frozen State funding and voter resistance to local tax increases. Understanding these constraints, Congress has funded innovative programs, chosen by those who have the experience and understanding of what it takes to produce results, our teachers.

In this respect, you are a part of a process which is seeking solutions from within, by offering new and exciting resources.

Just as we have learned in Parents as Teachers to build on family strengths, we find that through chapter 2, we can build on teacher strengths.

Their fresh ideas are both anchored and launched through your support, anchored in a process that is solid, and which fosters important discussions about learning, and launched by the possibilities new technology provides.

So I will close as I opened, and on behalf of our entire community, say thank you for your support of this funding. We are proud of the results of your investment. Please continue to work with us through title 6. We are building a future in our community that reaches out to the Nation. Thank you.

PREPARED STATEMENT

Senator COCHRAN. Thank you very much. It was good to have you come here from St. Louis. We know that you are not only head of the school district there, but you are also president of the Parents as Teachers Program.

[The statement follows:]

STATEMENT OF JOY ROUSE

I am honored to have been invited to speak to you this morning and to have the opportunity to say thank you for your support of innovation in education through Chapter 2 funding. I know that school districts nearly lost this source of revenue last year, and I am grateful for your role in preserving it for us.

Both professionally and as a community volunteer, I have seen the positive results of Chapter 2 funding. As deputy director of the Parents as Teachers National Center, I have seen Parents as Teachers (PAT) grow from four pilot projects in Missouri to more than 1,550 programs nationwide--programs which continue to demonstrate positive results for young children and families. Chapter 2 is a funding source for some of these programs; in fact, that is how PAT got started in Ohio.

As president of the Board of Education of the Parkway School District, I have seen the innovative programs through technology that Chapter 2 monies have allowed us to initiate, and I have talked with the teachers and children who have been their benefactors.

Parkway is a large suburban district in St. Louis County. We have a very diverse population of 22,000 students, including 3,300 children from the City of St. Louis who are bused out to us as part of a voluntary desegregation program. We also have 319 English as a Second Language students and 3,100 special education students who are a part of our regular classrooms. We are very proud of our District: 13 of our 27 schools have received the Blue Ribbon award from the U.S. Department of Education. But we also acknowledge that our teachers are facing greater challenges than they ever have before--and that they have greater competition for the attention and focus of their students.

If these teachers are to meet the competition of all the other things that are going on in a child's life and to meet the need to motivate reluctant learners, they must access the valuable opportunities technology has to offer today. School board members spend a lot of time working on policy issues, so when we really get out to see the children, it is a special treat. I can assure you that our classroom visits are now becoming truly exciting. It is astounding to me to see what students are able to do with the opportunities available to them through technology. Yes, our teachers can compete with the outlandish video games and TV shows for the student's attention and conversations.

Opportunities For Students

Chapter 2 funds have brought a variety of special technology-based projects to Parkway. Our students now have the ability to explore artistic masterpieces on laser disk and analyze their abstract representations; conduct computerized science experiments in biology, chemistry, physics and the environment; interact on CD-ROMs to explore a limitless body of knowledge on a variety of world cultures, including song, dance, food, language and beliefs; and solve complicated numerical computations, graphing, sloping and independent investigations--all on desktop computers.

In other words, Chapter 2 funding for technology has been used to enhance directly the basic core subject areas of math, science, history, literature and the arts. These learning activities have been supported through the purchase of

laptop and personal computers, work stations, laser disks, instructional software, CD-ROMs and a database of reference materials.

Among other school districts in St. Louis County using Chapter 2 funds for technology, Rockwood and Ritenour have purchased hardware and software; Hazelwood has begun linkage to the Internet for a high school library; and Ladue has provided a computerized catalogue system for its elementary and high school libraries.

Many times small changes can produce big results. A $200 grant for a CD-ROM reference collection opened up the world to our alternative high school kids. Our teachers know what will make the greatest difference.

Take, for example Adam, a third grade voluntary transfer student from the inner city who has learning and behavior disabilities, and suffers from Attention Deficit Disorder. As with many of our students, his home environment is very deprived and offers him little in the way of experiences that enhance school learning. Recently, Adam and his classmates were developing a research report on animal behavior. They chose a field trip to the St. Louis zoo in order to get close to the animals. But young Adam missed the field trip because his mother had worked late the night before and didn't get him out of bed that morning in time for his long bus ride to Parkway. Yet, because of a portable multimedia center purchased with Chapter 2 funds, there was another chance for Adam to be motivated to become part of this research activity, even though he missed the personal experience of the zoo trip.

The multimedia center is equipped with a Macintosh computer with a CD ROM. The CD disks from National Geographic offer moving, interactive videos of animals in their habitats with multiple visual images to cue reading comprehension. In addition, Adam's classmates had taken photos of their zoo experiences with the computer-assisted camera. They were able to download their actual snapshots into the hard drive on Adam's computer, and the zoo experience came alive on his screen. Computer software called Hyper Studio satisfied Adam's need for kinesthetic activity as well, which brought him not only the sight, but the sound and movement of the animals under study. In short, Chapter 2 funds used in the area of technology opened up Adam's world beyond an encyclopedia or a textbook or a chalkboard lecture. The integration of technology provided him with the educational tools and the motivation to become a researcher, writer and producer.

Computer equipment such as those described here can be a valuable substitute for missed opportunity in early childhood experiences and provide the active, sequential engagement needed to make the at-risk student a processor and a producer rather than a drop-out and a quitter. Small successes confirm in the at-risk student's mind that he or she does have the ability to succeed, and this perception can produce dramatic changes in attitude and progress. In this example, the technology is the generator--the initial influence that can reverse the cycle of failure for a young student who is developmentally delayed, deprived or disabled.

Still another example of Chapter 2 funds at work on the local level is illustrated in the case of James, a fourth grade special education student. James is often disoriented to the academic work of the classroom and resistant to teacher

direction and group instruction. But Lego Logo, a computerized robotics project, allows James to construct simple and complex machines with pulleys, gears, wheels and axles, and to move these machines, on a computer screen, to do meaningful, student-directed work.

The Lego Logo materials from Chapter 2 funds generated a turnaround in this child that was startling to the teacher and life-changing for James. He was immediately engaged with the hands-on kinesthetic aspect of building machines from Legos. The physics concepts with which he had struggled in his printed science text came to life in his hands and made sense to him. He became a problem solver in his own work and soon evolved into a trouble shooter for his classmates. Encouraged by his own new-found leadership role, James became more attentive to the computer aspects of the project. He was able to comprehend the logical, sequential directions necessary to program the computer for robotics.

Under normal classroom circumstances, such directions and sequencing would have to be modified for him by a special educator. James' interest in the materials provided by the Chapter 2 technology project elicited an interest in physical science that James had never experienced from his science book. This interest translated into a lengthened attention span, focus on details, and the perseverance necessary to deal with his learning disability.

There is also the whole issue of curriculum integration. Children have so much to learn these days, and teachers have so much to teach, that they must find ways to combine subjects and to manage time more efficiently. Technology plays a key role here as well. For example, lessons using Chapter 2 music software and equipment are far more than just music lessons! I observed children writing a score, listening to what they had composed, selecting musical instruments for study by determining where on the map of the world they wanted to focus, seeing and hearing that instrument, learning about the culture of the people who used it, and then writing about what they had learned. This multimedia experience was, yes, a strong music lesson, but also a vocabulary lesson, a writing lesson, a listening lesson, a geography lesson, a sociology lesson and a history lesson. This is the kind of efficiency that we must plan carefully. The most rewarding part for me was to see how engaged the students were with this project, and to hear their excitement about wanting to learn more.

Training For Teachers

One of the most significant opportunities available through Chapter 2 funding for Parkway has been the professional development classes for our teachers. We are entering a whole new world of education, so we really can't say, "Just go take another college class," and expect teachers to have the expertise needed to use technology effectively.

Our goal is to be sure that teachers can and will use the technology to teach our curriculum. Unless this training is given a high priority, then the equipment becomes merely a showpiece. This is no small task. With a faculty of 1,400, Parkway needs a combination of local, state, and federal funding to provide the training that is essential to move our teachers and students successfully into the 21st century.

I have seen these classes for teachers in action; the determination in the room is contagious. Mathmatica, Timeliner, Kidworks, Hyper Studio, and similar programs have been part of training sessions for teachers. This is what must occur in order to make our investment in equipment and materials pay off for students in a purposeful and productive way.

Federal Role

The existence of Chapter 2 is rooted in the perspective that the responsibility for providing exceptional educational opportunities for our children belongs to the entire nation--not just the local school district. We all have a stake in the success of our students. Federal support is vital to our continued and sustained effort in this area. School systems throughout the country are facing difficult financial futures. Despite carefully designed and administered budgets such as Parkway's, districts are being challenged financially due to economic slowdowns, frozen or reduced state funding and voter resistance to local property tax increases.

Congress has understood these constraints and has been committed to funding innovative and quality programs that are designed by those who have the experience and understanding of what it takes to produce results--our good teachers. In this respect, you are a part of a process which is seeking solutions from within by offering new and exciting resources. Just as we have learned in Parents as Teachers to build on families' strengths, we find that through Chapter 2 we can build on teachers' strengths. Their fresh ideas are both anchored and launched through your support: anchored in a process that is solid; and launched by the possibilities new technology provides. By continuing to support these funds you tell us that you believe these good ideas deserve to have destinations.

Chapter 2 grants not only supply needed equipment and materials, but also provide a springboard for conversation about teaching, learning and education among staff members. Such collegiality fosters trust, confidence and respect in a school community where teachers can become isolated. Yes, the process as well as the product has value.

So I will close as I opened, and on behalf of our students, teachers and our entire community, say thank you for your support of Chapter 2 funding. We are proud of the results of your investment. Please continue to work with us through Title VI. We are building a future in our community that reaches out to the nation.

MATHLINE

Senator COCHRAN. We have other panel members here with a program called Mathline, and we are going to have a hookup and a demonstration of how this works.

Our schedule calls for us to do that at right about 11 o'clock. So what I am going to do is question the other members of the panel about their testimony and discuss the issues that they raised, and then we will come to the Mathline, and have a demonstration.

The chapter 2 Program, or title 2, I cannot ever remember which one is in vogue now, and I hear the number has been changed.

Now, it is title 6, or something. So we are all going to be confused. But the difference between this program and others is that there are fewer restrictions, there is more flexibility.

Local grant recipients, or funding recipients, have the power to decide how these funds are used much more so than with other categorical grant funding programs.

Do you know whether the use of these funds, Ms. Rouse, around the country, are as they are in St. Louis, in terms of using the funds to buy equipment, or take advantage of technologies? Is this commonplace throughout the country, or is this the exception rather than the rule?

Ms. ROUSE. Well, I would have to use the St. Louis area as an example. Certainly, other school districts in our area are using these funds for technology.

One of our districts computerized their library system for access to research as well as catalogs. Another district is using it to access the Internet. Others are using it for hardware and software.

So I would say yes, if St. Louis area can be an example that you can trust school districts to use it for technology in appropriate ways.

Senator COCHRAN. One of the challenges is overcoming teacher resistance. Not all teachers, but some teachers are resistant to embracing new technologies. They may be frightened, or may be ill at ease about their ability to quickly learn how to use these computers, or other modern pieces of equipment.

What has been your experience? Is that a very serious problem, or do you think it is a problem that is easily overcome? What have your experiences been in that regard?

Ms. ROUSE. Well, I visited a class of teachers learning about technology, and the determination in that room was absolutely contagious. They were excited about the opportunities that it had to bring to their children, something new and very fascinating.

Yes, teachers are reluctant, but once they see children's reaction to these possibilities, they get excited, too. And they really do not want their classroom to be left behind, and they want to take a part of it. Once you get over that initial hump, teachers are very anxious to access this.

Senator COCHRAN. Teachers can be good students then.

Ms. ROUSE. Yes; they are wonderful students.

Senator COCHRAN. They are probably the best. Let me ask Dr. Carolyn Reid-Wallace a followup question about the Corporation for Public Broadcasting program. You talked about the younger students, and they are so important.

I know that some of the funds that we have made available in recent years have been for the development of educational programs that are targeted to this young audience, programs that would be interesting, that would attract their attention, and that would keep them from changing the channel to a cartoon that may not be quite as educationally beneficial.

Do you think these are funds that are being well utilized? Some have criticized those as providing funds to companies that ought to be developing these programs anyway, maybe for a profit, maybe to attract advertising dollars.

What is your view of that kind of seed money from the Federal Government? Has it been beneficial?

Dr. REID-WALLACE. I am absolutely convinced, Senator Cochran, that those moneys have been extraordinarily beneficial.

As a matter of fact, we have research that shows that little children who have an opportunity to watch the educational programs that have been funded by the Corporation for Public Broadcasting have actually demonstrated, through their proficiencies at first-grade level, a readiness for learning and for understanding materials.

So the long and short answer is the moneys spent by the Federal Government to support educational television programming, which incidentally is very high quality, has a tremendous payoff, and the payoff is that little children learn to speak the English language well.

They begin school learning to count, learning to think critically. And perhaps most of all, they begin school understanding that this world and, indeed, this country is made up of all kinds of people, people who bring a great deal to the table.

So it is a real investment that I cannot say enough about, and would urge you to think in terms of not only continuing, but if at all possible, increasing it.

Senator COCHRAN. One thing occurred to me when we were looking at options for funding adult literacy programs. There is a stigma in some communities attached to those who are illiterate. Some adults do not want others to know that they cannot read and write, that they are not literate. Trying to get people to come out and publicly participate in a program so that their neighbors know that they need this special help is a problem, and has to be dealt with.

It occurred to me that one of our options was getting people to go to the libraries, and you have the library-based programs. This is one approach that has been working.

But probably the most successful as any would be the use of one's television in one's home. Nobody is going to know that you are watching this special program on adult literacy, so there is no stigma attached whatsoever to that.

Have you been able to take advantage of opportunities to convey to those who may need special training in literacy, the adults in our population? Is there some special programming that might be designed to deal with that, or provide educational opportunities that otherwise might not be attractive enough to get people to participate? What has been your experience in that?

Dr. REID-WALLACE. Yes, sir; we have, and you are absolutely right. Many parents who have not acquired the necessary literacy skills are reluctant to go public and say it, but in the privacy of their homes, using their television, they are more than happy to take advantage of the opportunity to learn to read and to write, and CPB has supported a number of family literacy projects designed to do just that.

I might add that with the ready to learn program that we are at this moment talking about, there is a heavy component designed to help parents not only acquire the literacy skills through television.

But in some cases, our parents have the literacy skills, but they do not have the skills in the English language. And so it is a matter of trying to convey those skills to them.

We find that parents are willing to learn if they can save their dignity, if they can do it in the privacy of their homes, and if they

can do it studying materials that, in effect, respect them, and that are not condescending.

CPB is devoted to putting more money into the family literacy component of the Ready to Learn Program, because we know that it is important. Children need parents who can help teach them.

Senator COCHRAN. I am going to yield to my distinguished colleague from Vermont, Senator Jeffords, who has joined us, a member of this committee, also a member of the legislative committee on education. We appreciate very much his attendance.

Senator Jeffords.

REMARKS OF SENATOR JAMES JEFFORDS

Senator JEFFORDS. Thank you very much.

This is an exciting panel, and I have been waiting to talk to you. Unfortunately, I had some other things to do before I got here.

Tomorrow, I am hosting a summit on education here in Washington, DC, with education and business leaders from around the country, to try and figure out how we can catch up with our international competitors. In my mind, the only way we can catch up is through the utilization of our technology.

I have been a fan of technology in education for 20 years, but the only discouraging thing is that we have not made that much progress in the availability of computers for learning.

I worked in Baltimore with the employment training people back when using the Plato system, when one had to link through Chicago. I remember it well, because my daughter was having trouble with algebra. So I linked her up to Plato. But what I did not know was that she also had access to games.

And I got these horrendous phone bills, and I realized that perhaps things other than education have a better chance for success on computers.

Putting that aside, there are a number of areas where I think we need real help, and there are going to be tremendous costs if we don't replicate these needs around the country.

I just came back from visiting New York City and Baltimore, and they have incredible problems. There is the phenomenon of mobility, for example, in which the school year starts with, say, 500 students, and then in the spring you have 250 left of those who started, yet you still have 500 students.

I also noticed some of the differences in computer capabilities among schools. Some of the schools were giving a test, grading the tests, and storing the results on computers while others had virtually no computing capabilities at all.

Is any work being done to minimize the problems associated with mobility? For instance, is it possible to develop an IEP for students who are highly mobile with a tracing mechanism which could follow the student from school to school? Can any of you give me any thoughts on that?

Mr. CASADOS. Well, in the State of California, I am familiar with the work that they are trying to do, and that is creating a student information system for that very reason, and it is being funded under some of the technology allocations that are being made by that State.

But you are right, Senator, there is a tremendous movement of student population. I know that in California there is a lot of movement, and there is a tremendous need for keeping track of those students, because sometimes a student's entry into a different school will be delayed, because of the fact that medical records are not available, and there is a law that certain medical records have to be available.

So it is very critical that information systems be developed to adequately track students, because the capabilities exist to establish the information networks.

Senator JEFFORDS. Yes, Mr. Vance.

Mr. VANCE. Senator, I might just make a comment on another aspect of that problem that you have raised. Our organization, one of the distance learning organizations, along with some others, are looking at not only ways to track the records of students, and keep track of what is going on, but how can we anchor, how can we use the technology available to anchor those students, migrant workers, and so on, who need some stability in their lives.

One of the very easiest ways to do that, I think, using a technology that Mr. Casados mentioned, is the use of the telephone.

We use our telephone interactivity with audio bridge capability to link students all the time in classes. And if you were to consider extending that to a core of learning resources that may be available on cassette tapes, may be available on television, but the students, no matter where they travel, whether it be the migrant worker path, or whatever, could connect themselves to the same mentor week in and week out, as they traveled up the coast, or if they traveled from one place to another.

We think there is a strong need to do something like that, so that we not only track where the kids are, but give them some kind of an anchor, so there is some common thread in their learning.

Technology has the ability to enable our structures to do that. I think that is another consideration.

Senator JEFFORDS. Yes.

Ms. ROUSE. I would add to that a different perspective. In Missouri, we have the situation where school districts are not allowed to release information to other school districts, unless a parent gives us that permission, that the whole issue of confidentiality comes into it.

And we have some parents who do not want the next school district to know what their child has done in their first district. So that is an issue and a problem for districts.

Mr. CASADOS. Well, additionally, talking about mobility of students, today we have the technology to deliver instructional programs on a nationwide basis, so that no matter where a student could be, there could be that continuity, if we have a national distribution.

Our program, for example, is now reaching over 50,000 students in 21 States in our first year of operation, which gives us a technology that can reach every corner of this country, so no matter where a student may be moving, there can be a certain core instruction that is always available and accessible to the students.

And I think technology can be that equalizer, as I mentioned in my testimony, to provide a basic enrichment on a nationwide basis.

Dr. REID-WALLACE. I would like to add to that very briefly, that while the Corporation for Public Broadcasting did not necessarily, when it created the program CWEIS, which means community-wide education and information service, envision tracking students, it did, in fact, seek to find a way to use technology that did not cost a great deal of money to hook children and their parents into an ongoing service that could be instructive and also—not only educationally instructive, but instructive in terms of learning the new-wave technology.

So what we have done over the last 2 years is to give money to 12 different States to hook their young people, using televisions, computers, modems, and telephones into a service that provides exactly what you said your daughter needed, which was mathematics.

So any child in these 12 States interested in having a mathematic tutorial can access the computer, the telephone, and the television, and get instruction that is provided free of charge by retired engineers, retired professors of mathematics, teachers of mathematics, and the teachers are in their homes, not at the schools.

They can do it from their homes, because they, too, are using a modem, a computer, and a telephone.

Senator JEFFORDS. What, of course, is of concern, if we are to make the leap forward as I would like, is the cost of providing equipment.

I had an analysis done which indicated that it would take $15 billion just to fully equip the existing schools, to bring them up to some sort of a reasonable standard, and then another $6 billion a year to keep them all running.

How in the world do we take that leap forward? Can we look to business to give us help?

Mr. CASADOS. Well, I think the connection to the technology in many instances can be a telephone line. Once the telephone line is installed, and that is a big obstacle in American education today, is having a telephone line, but once that telephone line is installed, it becomes a flow of cash to the telephone companies, and so there is a business aspect to that operation.

Additionally, the cost of delivering instruction by a television has dropped dramatically. We use a little 18-inch satellite dish, which we give away to the schools at no charge, but it can be purchased for $695, and will probably be dropping in price.

So I think you are right, Senator, the cost of wiring schools for the 21st century is an investment that is high, but I believe it has to be made, and I think it has to be a partnership between those that provide the services and those that benefit from the services that can be delivered through that infrastructure.

Senator JEFFORDS. Thank you, Mr. Chairman.

Senator COCHRAN. Thank you.

Ms. Rouse, do you want to comment on that question, too, before we do our Mathline demonstration?

Ms. ROUSE. Yes, very briefly, I do, because as a school board member, I would have to say to you, I think we do not have to leap. And you had asked, Senator Cochran, about teachers' reluctance to get involved in this.

If we leap and say, you all have to do it right now, then the teachers do get nervous.

But if we are comfortable enough to bring this into our schools gradually, then the teachers accept it better, and the investment is more palatable as well.

Senator JEFFORDS. What do you say is gradual?

Ms. ROUSE. Over a period of a couple of years, because it takes that time for people to accept it.

Senator JEFFORDS. I understand. And that is one of the biggest problems we have—nurturing the teaching profession as well as my profession. We all get scared. I have my computer, and I am calling for help more often than I would like to admit.

Ms. ROUSE. And when a teacher sees the teacher next door really engaging her students, she is going to be ready the next year to have that capacity in her classroom.

Senator JEFFORDS. I find that the kids can teach the teachers in many cases, too.

Ms. ROUSE. And should.

Senator COCHRAN. Let us now go to our panelists, Ms. Joan Miller and Ms. Beryl Jackson, for our Mathline demonstration.

I think what I will do is excuse the remaining members of the panel, and ask Ms. Jackson and Ms. Miller to move to the center of the witness table for their presentation.

Thank you all so much for your contribution to the hearing. We appreciate it.

QUESTION SUBMITTED BY SENATOR ERNEST F. HOLLINGS

Senator COCHRAN. For the record, Senator Hollings has submitted a question to this panel, which we will furnish and ask that you respond to, for the record.

[The following question was not asked at the hearing, but was submitted to the Corporation for Public Broadcasting for response subsequent to the hearing:]

QUESTION SUBMITTED BY SENATOR ERNEST F. HOLLINGS

Question. I understand that the Corporation for Public Broadcasting has already been working with public broadcasting stations to carry out the goals of the Ready To Learn Act. What has been you experience so far with readiness to learn?

Answer. CPB's educational vision speaks to our commitment to use the capacity and potential of our existing infrastructure and evolving technologies toward education of the highest quality for all citizens—no matter who they are or where they live—on a non-fee-for-service basis. PTV: The Ready To Learn Service on PBS is public broadcasting's vision at work in the world of very young children, their parents, and their caregivers. In a real and profound sense, Ready To Learn is a national education program, a mighty combination of the best that public broadcasting has to offer—on and off the air—marshalled for the foundational education of young children.

The focus of Ready To Learn is children; parents and caregivers are educated as well, and their efforts and energies are enlisted in the education of their children. Public broadcasting's universal access fuses with the power of television itself, the proven educational power of PBS' children's programming and the power of public broadcasting's national technological infrastructure and network of community resources—351 public television stations—to create a lively, solid course of study designed to help all children begin school ready to learn, and to continue to experience learning in school positively and enthusiastically.

In the last decade or so, research has made clear the vital importance of the years of early childhood; they are the pivotal gateway to many aspects of further development. Children who miss out on key steps in cognitive, affective, and social develop-

ment during the preschool and early school years are most likely to continue miss-ing—and losing—all the way through school, and perhaps through life. On the other hand, children who in those critical years receive age-appropriate instruction, rein-forcement, and attention tend to continue learning and thriving. These are the steps by which all young children become ready to learn. And the use of television can be a primary force in providing this essential instruction and reinforcement.

In Ready To Learn: A Mandate For the Nation, Ernest Boyer identifies the impor-tance of television as a significant influencer of children. "Next to parents," he states, "television is a child's most influential teacher." Television carries this influ-ence because, among other factors: a 6-month-old infant watches one and one-half hours of television per day; a 5-year-old watched 2½ hours of television per day; by the time a child enters kindergarten, he or she is likely to have spent 4,000 hours in front of a television set; all told, the nation's preschoolers watch a total of 14 billion hours of television every year.

The use of such universal and commanding technology toward the education and benefit of children is essential; it is the vision and the work of public broadcasting.

As a result of CPB's and PBS's commitments to Ready To Learn, public tele-vision—currently in its first year of Ready To Learn Service—is already reaching children, parents, and childcare providers in half of the families in America—in 46 million homes and daycare centers. They are learning through the potent combina-tion of television programs, educational messages, printed guides and other learning materials, free books for children, and workshops for parents, daycare providers, and pre-school teachers. Ready To Learn is only nine months old, and already the results are impressive.

Daycare providers in Boston neighborhoods report that as a result of training they have received from WGBH's Ready To Learn Service, they are beginning to see themselves—rightly—as important teachers of the children in their care, placing more value on themselves and on their work. Moreover, the children in their care often ask to be read books that they have seen on Reading Rainbow or Storytime. They are exposed to literature from a variety of sources—video, television, books, and storytelling—and therefore, have this necessary step toward literacy.

Children in Miami, in Charleston, WV, in towns across Massachusetts and across the country are learning through the combined power of these elements:

—An average of 8 hours of continuous children's programming of the highest qual-ity, focused on the cognitive and social development of boys and girls from many different social, cultural, and geographic backgrounds. These programs include Sesame Street, Barney and Friends, Mister Rogers' Neighborhood, Reading Rainbow, and others which research has repeatedly shown do in fact educate children. The 1993 National Household Education Survey is the most recent in a series of research studies which have found that these programs do indeed have a broad and diverse audience, and that they do indeed teach; 88 percent of all preschoolers and 80 percent of all kindergarten students in the United States watch one or more of these programs, regardless of their parents' level of education or income.

These pre-school children—this 88 percent who watch these programs on PBS—are more likely to be able to identify colors by name, count to 20, recognize letters of the alphabet, and tell connected stories when pretending to read than the pre-schoolers who do not watch these programs.

—A series of lively, educational, between-program messages for children and adults presents a seamless and uninterrupted block of learning. Instead of com-mercials, children watch these compelling and energetic breaks and learn ways to gather information, try new things, ask for help from an adult, and complete tasks.

—Learning guides and educational materials are distributed to parents, children, and other caregivers. The materials focus on children while strongly encourag-ing a dynamic and positive interaction between child and adult. These re-sources, developed and tested by early childhood experts, reflect sound edu-cational principles, and are designed to help adults extend their children's tele-vision learning through reading, reasoning, and other home follow-up activities which promote continuing intellectual curiosity and family literacy.

—New, free books for children who have never owned books of their own have been introduced as a result of the Corporation for Public Broadcasting's partner-ship with First Book, a national non-profit organization dedicated to providing new books to disadvantaged children. Each month children can select and keep new books of their own choosing at several Ready To Learn sites. These books are often distributed at station-sponsored family events at which parents and children read together.

—Workshops organized by each local PBS station through partnerships with local community groups such as Head Start, AARP, Even Start, and local schools and libraries are provided for parents, daycare providers, pre-school teachers, and other members of the community in order to introduce them to ways to use children's television programming, related materials, books, and local library and educational initiatives to help their children get ready to learn. These workshops are led by the station's Ready To Learn Coordinator or another highly qualified community resource—pre-school teacher, children's librarian, or teacher educator.

—At Ready To Learn's 10 initial sites, from last July through December, 5,000 parents and daycare providers participated in learning workshops, and tens of thousands received printed educational materials in the mail or through partnering community organizations. At First Book's three Ready To Learn pilot sites, 67,000 new books have been distributed to children during that period. Since January 1995, Ready To Learn has expanded to thirty-two stations; this growth will continue through 1997.

Since America's needy children are geographically distributed in large and small, urban and rural population centers across the country, and since only 66 percent of America's households receive cable—at an average cost of $250 per year—public broadcasting is already providing necessary and meaningful education to the American citizenry. In part because its broadcast technology is simple and cost effective, public broadcasting reaches virtually all children and families regardless of the economics of their neighborhoods; 99 percent of American households have access to public television, and the children in those households, their parents and their caregivers, can receive the benefits of Ready To Learn.

STATEMENT OF BERYL JACKSON, PBS MATHLINE, ALEXANDRIA, VA

ACCOMPANIED BY:

    JOAN MILLER, MATH TEACHER, WEST SYLVAN MIDDLE SCHOOL, PORTLAND, OR

    SANDY WELSH, PUBLIC BROADCASTING SYSTEM

Senator COCHRAN. Thank you very much for being here. Tell us what we are about to do.

Ms. JACKSON. Good morning. I am Beryl Jackson, a D.C. middle school math teacher working with PBS Mathline. This is my fellow math teacher, Joan Miller, from Portland, OR.

On behalf of PBS Mathline, we thank you for allowing us to participate in this hearing.

Senator Cochran and Senator Jeffords, America has 1.6 million mathematics teachers. We were the first to develop a rigorous new framework for what students should know and what teachers should teach.

Now, the challenge is to upgrade teachers' professional skills to help students achieve world-class standards, and our country maintain its competitive edge in the global marketplace.

Telecommunications technology is the only cost-effective way to accomplish this retraining. For this reason, Mathline was formed. The National Council of Teachers of Mathematics led the grassroots development of this new framework.

PBS is the telecommunications partner that can make the classrooms of America. It has a national telecommunications highway in place, and local stations that support teachers. Joan.

Ms. MILLER. Senator Cochran and members of the subcommittee, teachers are among the last professionals in America with no telecommunications with the outside world. Mathline is changing all that. Oregon Public Broadcasting has brought Mathline to me and other teachers throughout our State.

With Mathline's 25 videos, we can see other teachers using innovative teaching strategies. Then when I have time, I log on to fa-

cilitate discussions among the teachers in my online learning community to talk about how we can apply these models in our own classrooms.

Mathline got started with support from the private sector and PTV. We math teachers thank these funders for their vision. Now, to reach teachers across the country we need your help.

We commend you, Senator Cochran, and for the record, Senator Hatfield and the rest of the appropriations committee for preserving fiscal year 1995 funds for the mathematics telecommunications demonstration project and other education technology programs.

PREPARED STATEMENTS

We ask that you continue to support the math demonstration project in conference committee and in the fiscal year 1996 bill. It is the best investment Congress can make for education reform.

Senator COCHRAN. Thank you.

[The statements follow:]

PREPARED STATEMENT OF BERYL JACKSON

Good morning. I'm Beryl Jackson, a District of Columbia middle school math teacher working with PBS Mathline. And this is my fellow math teacher, Joan Miller, who is from Portland, OR.

Mr. Chairman, members of the subcommittee, America has 1.6 million mathematics teachers. We were the first to develop a rigorous new framework for what students should know and what teachers should teach.

Now the challenge is to upgrade teachers' professional skills to help students achieve world class standards and our country maintain its competitive edge in the global marketplace.

Telecommunications technology is the only cost-effective way to accomplish this retraining. For this reason, Mathline was formed.

The National Council of Teachers of Mathematics led the grassroots development of this new framework.

PBS is the telecommunications partner that can link the classrooms of America. It has a national telecommunications highway in place and local stations that support teachers.

PREPARED STATEMENT OF JOAN MILLER

Mr. Chairman, members of the subcommittee, teachers are among the last professionals in America with no telecommunications with the outside world. Mathline is changing all that.

Oregon Public Broadcasting has brought Mathline to me and other teachers throughout the State. I'd like to recognize Maynard Orme, general manager of OPB, who is here with us today.

With Mathline's 25 videos, we can see other teachers using innovative teaching strategies. Then when I have time, I log on to talk with the teachers in my on-line learning community about how we can apply these models in our own classroom.

Mathline got started with support from the private sector. We math teachers thank these funders for their vision.

Now to reach teachers across the country we need your help. We commend you, Senator Hatfield and Senator Cochran, and the Appropriations Committee, for preserving fiscal year 1995 funds for the Mathematics Telecommunications Demonstration Project and other ed/tech programs. We ask that you continue to support the Math Demonstration Project in conference committee and in the fiscal year 1996 bill. It's the best investment Congress can make for education reform.

MATHLINE TEACHERS

Ms. JACKSON. We would now like you to hear and see brief testimonials from other Mathline teachers from around the country.

Mathline gives us a variety of technologies. We use videos, video conferences, E-mail, and now we are going to show you one of the special elements, the online chat. You will have a chance to take testimony via Mathline with educators from your home States.

Senator COCHRAN. I think the first thing we have to do is go online with the teachers. Now, we are going to have to figure out how to do that. [Laughter.]

Can the PBS staff come up here and give us a quick course on how to go online with the teachers? There may be other Senators' staffs here whose Senators are delayed in getting to this hearing who would like to join us at the hearing table. Feel free to do that.

Ms. JACKSON. Senator Cochran, Connie Murphy is a brand new Mathline facilitator from Mississippi. I have not met her personally, but I have met her online and on the telephone. She is here to speak with you.

Senator COCHRAN. Great. She has been in our office here in Washington.

Ms. JACKSON. Oh?

Senator COCHRAN. Yes; now, we are logged on, and we have joined the chat.

And she has sent me a message that says: "Hello, Senator Cochran."

That is exciting. [Laughter.]

I guess I say: "Hello, Ms. Murphy."

I need to ask her a question, I suppose. Now, the other Senators have logged on, and they are chatting with someone in their State now——

Ms. JACKSON. Yes.

Senator COCHRAN [continuing]. Who is a math teacher in their State. Could you give us the names of the teachers, or do we know that, in Vermont, for example, and Arkansas?

Ms. JACKSON. In Vermont, we have Bob Kinney. And that will show up.

Senator COCHRAN. Yes; Bob Kinney has taken off and written a whole sentence. [Laughter.]

Oh, I have a big message here myself. Well, so the record will know—I guess the hearing record can record this. This is a virtual hearing, in case you are wondering what the name of this is. We are virtual Senators. [Laughter.]

You better be careful what you say.

They are putting what you say, Jim, up on the board.

Now, they are going to put up what I said. Here is what Connie Murphy just told me, that she believes that the key to improving math educational levels in the Mississippi Delta is the improvement of instructional techniques in the classroom. She is saying more now.

Now, we are getting to see what Senator Jeffords and his teacher, Bob Kinney, are saying to each other. Bob Kinney talks about how teachers need to work with each other, and support a change, and this medium provides much more equal access to our rural population.

I have just sent a question to my teacher. I was curious to know how her school is able to finance the purchase of equipment to use in this program. We will see what she tells me.

I have just been advised that what we will do to make this all a part of the record is we will print out hard copies of these exchanges, questions and answers. Have you just done something you do not want in the record? [Laughter.]

And then we will have them submitted for the reporter to include as a part of the transcript of the hearing.

Ms. JACKSON. Yes; all of that will be provided for you.

Senator JEFFORDS. After appropriate editing.

Senator COCHRAN. That is right. Senators have the opportunity to revise and extend, or revise and delete. [Laughter.]

[The information follows:]

THE PBS MATH SERVICE

1. What is PBS Mathline?

Mathline is a new education service from the Public Broadcasting Service (PBS) that provides resources to students, teachers, parents, and the general public as they strive to make United States students reach world-class standards in mathematics achievement.

Mathline will take advantage of a wide range of technologies—video, computer, satellite, broadcast—to make these resources accessible, flexible, and effective. Public television stations are ensuring Mathline's success at the local level.

2. Are the services of Mathline aligned with the curriculum, teaching, and assessment Standards set by the National Council of Teachers of Mathematics (NCTM)?

Yes. In fact, from the very conception of Mathline, the National Council of Teachers of Mathematics (NCTM), along with PBS, has been instrumental in planning and developing the service. An advisory committee comprising the NCTM President and Executive Director, mathematics teachers, supervisors, teacher educators, and mathematicians representing NCTM has been active in ensuring Mathline's alignment with the NCTM Standards. Furthermore, this committee helped to establish the priority services for Mathline and focused them on the needs of students, teachers, and schools.

3. What resources are available from PBS Mathline?

The first Mathline resource is a year-long professional development experience for teachers of middle school mathematics, grades 5–8. This experience, the Middle School Math Project (MSMP), was launched with 500 teachers in 16 States in 1994–95 and will quadruple in the number of participants in 1995–96.

Also launched as part of Mathline in 1994, was the PBS Mathline/Cellular Telecommunications Industry Association (CTIA) Foundation Wireless Demonstration Project, which enables math teachers to connect to resources, information, and to each other whenever and wherever it is convenient for them, even if they don't have access to telephones or computers in their schools. Working in partnership, PBS, its local member stations, and the CTIA Foundation—with contributions from its cellular companies—have provided wireless laptop computers with cellular modems and free air time to math teachers in six States. The wireless technology provides access to Mathline for teachers across America who have few telephones, little access to computer technology, and almost no way to join the information highway. CTIA also provided partial funding for an electronic resource center for math teachers.

Other services in the planning stage include professional development programs for grades K–4 and 9–12 teachers of mathematics, instructional and motivational programming for students, and programs to help parents participate in the mathematics education of their children.

4. How does PBS ensure quality in its Mathline service?

Two advisory committees of Mathline assist in assuring quality services and local autonomy. One is a committee of math teachers, supervisors, teacher educators, and mathematicians representing the National Council for Teachers of Mathematics. The other is composed of general managers and education directors representing public television stations.

MATH TEACHERS

Senator COCHRAN. OK.

Ms. JACKSON. There used to be, I guess, a joke among math teachers that a lot of time math teachers became math teachers be-

cause they did not have to read and write, so then look at it that way. We just had to do math. [Laughter.]

Senator COCHRAN. Our teacher has now responded to my question about where her school got the money, and you may see that she said that they used chapter 2 funds.

So as we were talking a while ago with Joy, from St. Louis, that program is not only available in St. Louis for the use of funds to buy equipment of this kind, but in Mississippi as well.

We are glad the chairman of the full committee has joined our hearing. Senator Hatfield, welcome.

You are logged on, I suppose, as a part of a chat with teachers throughout the country about mathematics and the use of Mathline, a PBS program that we are hearing about.

Senator HATFIELD. I am afraid, Mr. Chairman, that I know so little of the technology, that I am going to rely upon some staff here.

Senator COCHRAN. Do not worry. We have plenty of staff here.

Senator HATFIELD. I would like to send greetings to this Oregon teacher. I am so pleased to be able to be here to engage in this demonstration.

Senator COCHRAN. Well, you are ahead of us a little bit, because Ms. Miller is from Oregon, and she has helped put this whole thing together here.

Senator HATFIELD. Do I type this, or do I just speak?

Senator COCHRAN. There is your consultant on your left. [Laughter.]

I thought he was kidding. [Laughter.]

Ms. MILLER. Senator Cochran?

Senator COCHRAN. Yes, Ms. Miller.

Ms. MILLER. This is, in fact, one of the reasons a lot of us like to have the computer at home and we do it in the evening, and no one knows how long it takes us to type things.

Senator COCHRAN. Incidently, you might be interested to know that Ms. Murphy, back in my State, has told me some other things about how equipment can be obtained for use in a program like this.

She mentions that the students can use home computers and a modem, and that some also have computers that have been donated by private businesses. Another opportunity is to leverage some Federal dollars through Chapter 1, and then you see others contributing from private sources, adding to the resource for the schools.

I have not seen any of the questions and answers from Senator Bumpers up on the line there.

Senator BUMPERS. We have just been corresponding about what a great President Bill Clinton is. [Laughter.]

Senator COCHRAN. They probably censored it.

There is a little lobbying going on here. [Laughter.]

There is nothing wrong with that.

Let me ask the witnesses here, Ms. Jackson and Ms. Miller: Could you tell us how the schools and teachers are selected to participate in this program? Is there a limitation on how many can be involved? Is it up to everyone's own individual initiative about joining this program?

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Ms. JACKSON. Well, this is a joint venture between the public television and the local school districts. The public television station representatives contact the local school districts to let them know about Mathline, and what Mathline has to offer.

In addition, we, from the national headquarters, do quite a bit of advertising about Mathline, and teachers call their public television stations. And through the public television stations in the school districts, teachers and schools are selected.

So I think it is a pretty nice partnership between public television and the school districts, and it is joining maybe two entities that may not have worked as closely together very close with this new project.

Senator COCHRAN. Senator Jeffords, do you have any questions you would like to ask of the witness panel?

Senator JEFFORDS. First, I am just fascinated. It was wonderful to talk to Bob Kinney, of my State. He was able to decipher my typing, fortunately.

I just think it is incredibly important that PBS is doing this. I guess my questions would be around the most efficient and effective way for us to replicate the availability of these programs to our schools.

And what is the limit of what you can do right now, as far as— I do not know how many school districts or how many schools we have in this country.

But, obviously, in order for us to get—I do not think you saw the chart earlier, where we are dead last in math, and I know you are well aware of that. And yet we do know that we have some of the brightest math kids in our schools.

The question is: How do we get the average of our math up to the world-class standard? How would you suggest we start?

Can we start somewhere up the ladder, and get curricula corrected, or do we have to start in grade one, or where do we start to get our young people up to par with Taiwan, and Bonne, and other places?

Ms. MILLER. Well, we do hope that with increased funds that Mathline will expand and become a truly national project. We are looking to expand it to teachers of other grade levels, since we are currently serving middle school math teachers.

We would like to expand to serve elementary and high school teachers, so that teachers of all grade levels have access to the kind of professional development that the small number, the 500 of us, now have for learning through online and through the videos.

So that is the process that we are looking forward to, becoming a self-sustaining program once we have been able to expand and have the additional materials for training teachers at the other levels.

Ms. JACKSON. I would like to add that I believe you should start wherever the student is. I teach middle school, and some of my students were on various levels, and so it is up to me to do my best for them wherever they are.

So in terms of where do we start, there definitely has to be a plan, and we are with the middle school math project, and Mathline started at the middle school level, but Mathline is designed to assist teachers with their students regardless of the

grade level, and wherever the teacher is and wherever the student is.

Senator JEFFORDS. With respect to students' abilities, this should give them the capacity to leap beyond the present structure as far as their core curricula to jump 1, 2, or 3 years ahead, if they want to.

Is that something which we should encourage, or would that foul up the whole system?

Ms. MILLER. Well, the Mathline itself is aimed in particular at the professional development of the teachers, and the things that they learn are what they use in the classroom to help the students.

So we are not looking so much at advancing students, in terms in the use of Mathline. A lot of discussions online have been around topics like that.

For example, the question of having algebra in eighth grade has been a continuing discussion, where teachers around the country have talked about: Should eighth graders be taking algebra? Is that a good idea? And if so, under what circumstances, and how?

So Mathline gives us a community or a forum to talk about those issues, and find out what people in other districts are doing. It is not a case of making policy about those things, but it is a way for teachers to share information about it.

Senator JEFFORDS. I know, for instance, how when I was in Taiwan, that their kids are getting calculus in freshman and junior years of high school.

If we are going to move from dead last with our average in math up to somewhere up with our competitors, we either have to wait 12 years and start everybody in the first grade, or we have to figure out some way with software, or other technologies, to allow young people to go ahead at the level they can, in order for at least a larger number of our students to score better on these international exams.

Ms. MILLER. Right; in Oregon, we have a State reform initiative which is aimed at allowing that kind of transition for students who are ready to move ahead, and to kind of continually assess, according to some benchmarks, how students are progressing, and for those who are not meeting those benchmarks, to receive some additional support.

That includes other work in school, access to technology, and also work with parents.

Senator JEFFORDS. Thank you.

Senator COCHRAN. Senator, thank you.

Senator Bumpers, do you have any questions of the panel?

Senator BUMPERS. I am so boggled, I do not have a question to ask. One thing I do want to ask is: At some place at PBS, I assume there is a modem or a matrix that is used for all students of a certain level.

For example, when you are in the classroom and your students have this in front of them, and you make connection with a mainline computer, is everybody involved studying the same subject and the same algebraic equations?

Ms. MILLER. Well, Mathline itself is not set up for the student to use, particularly. It is a community of teachers, and their use is for professional development.

Because Mathline was available, some teachers then acquired modems and computers that they did not previously have, which allows them then the option of having some other kind of service that they can use for students, say, for example, for Internet access, where they might not have previously, because they did not even have a computer.

But at this point, it is a network of teachers talking to each other.

Senator BUMPERS. I was not here for the testimony earlier. Is there a Federal program specifically to fund this program, or do you have the option of using certain kinds of Federal funds for this?

Ms. JACKSON. Currently, we are using private funds, and we are using funds from public TV.

Senator BUMPERS. Well, how many classrooms in this country have this available to them?

Ms. JACKSON. Currently, we have approximately 500 teachers on-line, and we are looking to upgrade that to 2,500 in the next academic year.

Senator BUMPERS. What do these computers cost, $2,000?

Ms. JACKSON. Well, the teachers are using computers that were built, I guess, 20 years ago, up to the modern computer, so it depends on what the teachers have access to.

Senator BUMPERS. Could you just use any old computer that you can buy on the used market, for this purpose?

Ms. JACKSON. They have been able to configure the software so that it will work on almost any computer. Now, it works best on the newest models, but teachers have been able to use the software on antiquated equipment, and many of them do have antiquated equipment, I might add.

Senator BUMPERS. When I get into this system, who am I getting on the other line? If I am a classroom teacher, and we are going to spend the next 45 minutes on some function of algebra who are we going to get on the other end?

Ms. JACKSON. Currently, you will get another middle school math teacher, and together, the middle school math teachers are working out some of the problems and some of the successes that they have, in terms of teaching middle school mathematics.

That is currently what is happening. Now, I think our vision is to include students, but that is part of the vision.

Ms. MILLER. Maybe I should explain, too, that the chat that we demonstrated this morning, where it was a direct—you made a comment, they responded back, is actually a small part of what the Mathline online program is.

Senator BUMPERS. I see.

Ms. MILLER. A really bigger part operates like e-mail, where I have a problem with a particular lesson I have tried, I post a question in the evening, I use it at home, and then the next day I log in again and check, and in the meantime, other people have read my question and have left answers to it.

So more of that happens than does the real-time directly talking back and forth kind of situation.

Senator BUMPERS. Mr. Chairman, I just have to do a handson operation to fully understand this. I would really like to go to a class-

room and see the thing function in that setting. That is the only way I am going to ever get it. It is probably a good——

Ms. MILLER. I am sure that could be arranged.

Senator COCHRAN. It is probably a good idea for all of us, to take advantage of opportunities to do that. Senator Hatfield is busy talking to somebody. [Laughter.]

Ms. Jackson, you wanted to——

Ms. JACKSON. You had asked about the funding.

Senator COCHRAN. Yes.

Ms. JACKSON. May Sandy Welsh, from PBS, please come——

Senator COCHRAN. Sure.

Ms. Welsh, please come forward, and help us understand this better.

Ms. WELSH. Great; well, I think, actually, Senator Cochran, you understand it quite well, because we appreciate your leadership, Senator Hatfield's, and others, and early on, recognizing the potential of this.

Consequently, there was, in the ESEA bill, a line item for a math telecommunications demonstration project, and actually, $2.25 million was appropriated for fiscal year 1995, and actually, there is a 5-year authorization to try to demonstrate this on a larger scale for math teachers at all grade levels across the country.

Now, as you know, the House, in the recision effort, zeroed that out; however, it is my understanding that the Senate, in their deliberations, has that money still in and that the decision will be made in the conference committee.

But in order for teachers like Joan, and the others around the country that are so eagerly embracing this technology, in order for us to see this really develop nationwide, we very much need this Federal support in this national demonstration project to bring this to teachers in all 50 States.

Senator COCHRAN. Thank you very much.

Senator Hatfield.

REMARKS OF SENATOR MARK O. HATFIELD

Senator HATFIELD. Mr. Chairman, I think it is very obvious that this is a wave of the future, and perhaps we should say, the wave of the present.

When I sponsored the legislation, we had engaged in considerable discussion relating to the whole field of the Federal role in stimulating the deficiency we found in math and science.

When Senator Kennedy and I first introduced a bill calling for a math-science focus leading to the consortiums. I attended consortiums across the country to reach out into the local areas, to find what was happening, what was innovation, what was the creative work going on.

We seem to be far from the goal that this represents here today, in that the disbursement of information and the use of this type of technology has just exploded.

There is one very special thing I would like to point out—do you remember when we were talking about Goals 2000, and there was a lot of debate about national standards, and local standards, and all of that kind of debate, I would say to my colleagues that in the math field, the mathematics teachers have distributed and have

really disbursed the idea of standards through this very network, so that math standards no longer are divided at the Federal, State, or local levels.

They have totally blurred those lines, and removed those barriers that we were debating about, because technology knows no political barriers and divisions, so those standards are out there now as part of the, you might say almost as if they were bubbling up into the profession, rather than being imposed from some kind of a political power base back here.

To me, that is one of the dramatic things that has happened with technology. It does not know political boundaries. It makes use of the information, it does not argue about how to get it, because it is there, and now it is immediately available. I think that is a very important advance, too.

Senator COCHRAN. Thank you very much.

I suppose we should move on now. We do have a final panel of witnesses we want to hear from, in order to round out our hearing record, and to complete our inquiry that we have scheduled for today.

Thank you, Ms. Jackson, and thank you, Ms. Miller, for your excellent contribution to the hearing, and thank you PBS and all the staff who are here to help us understand how to participate.

STATEMENT OF MARGARET G. KELLY, PRESIDENT, INTERNATIONAL SOCIETY FOR TECHNOLOGY IN EDUCATION

Senator COCHRAN. The next panel consists of Dr. Margaret G. Kelly, president of International Society for Technology in Education; Dr. Jeanne Hayes, president, Quality Education Data, in Denver, CO; Dr. Anne Miller, who is the education segment director of Eastman Kodak Co., in Rochester, NY; Ms. Kathleen Fulton, Project Director of the Office of Technology Assessment, here in Washington; and Dr. Linda Morra, Director of Education and Employment Issues, of the General Accounting Office.

We appreciate very much your attendance and assistance with our hearing this morning. I am going to ask Dr. Kelly to begin with her statement. I want to remind you all that we are still under the 5-minute rule.

If you could please limit your statement to 5 minutes, that will give us an opportunity to engage in a discussion in the issues that you raise.

Dr. Kelly, you may proceed.

Dr. KELLY. Good morning. My goal is to be done before the yellow light goes on. I am Peggy Kelly. I am currently president of the International Society for Technology and Education.

I am a veteran of 16 years in the classroom, and am a teacher-educator at California State University, San Marcos. My testimony is in for the record, so I am going to edit it considerably, considering what you have just heard this morning.

What I am going to start with is to give you a sense of the power of the technology, and why teachers need it, and what does not exist there, and I am just going to tell you a story.

The story is of my daughter Melissa, who, at age 9, was studying space, astronomy. Each child in her classroom was given a topic, and she selected space food.

She came home and she said: "I looked up in the encyclopedia in school, and it said, 'Astronauts eat freeze-dried food.'" Encyclopedia No. 2: "Freeze-dried food is what astronauts eat."

She went to the library, everything on astronauts and food had been checked out.

So she came home and she said: "Do you think there is anything on that computer that has anything to do with freeze-dried food, or astronauts, or anything?"

So we logged on to a resource called NASA Space Link. It is menu-driven. I just let her go.

She went into the menus and she looked, and she perused, and she said: "Oh. Bianca can use this. Oh. Oh. Oh."

She was very excited. She found some information that she needed, but she was not quite satisfied. It was now 9 o'clock at night, on a Thursday night.

She said: "I have to get off. I have to get off."

So she went to the log off, and it said: "Do you have any questions for NASA?"

A light went on in her head, and she said: "I can type in the rest of my questions."

So she typed in the rest of her questions.

And the lower spot said: "You will receive an answer in 24 to 48 hours."

So the next morning, 6 a.m., the child who does not get up in the morning, is up at 6 a.m. She watched me log on. She logged on herself.

I got into the room where the computer was. She had a response from whoever monitors NASA Space Link, who guided her through the menus to some places where she could find some information on space food, how it was manufactured, and dietary needs of astronauts.

She printed it out. She also found some information on a local resource who manufactures the space food. Some 12 pages later, she had this little packet of information, plus information she had downloaded for her friends at school.

She went to school, gave the information to a teacher who does not have a telephone in her classroom. So therein is what we are dealing with in education, a situation where in many cases the home has more technology than the school itself.

And you experienced yourself, the kind of thing where you got engaged in what you were participating in this morning, you were a little less reticent to listen to what was going on out here, and lot more interested in what was going on on the screen.

This is, in fact, what happens to kids, the excitement for learning, the ability to peruse different kinds of resources. This is the kind of information technology we want to make available to our students.

One of the other hats I wear as part of the Star Schools Project, the team's project out of Los Angeles County Office of Education—I did not make it.

Senator COCHRAN. That is all right.

Dr. KELLY. The team's project is a distance-learning project that puts a teacher on the air, live, teaching mathematics.

That particular project has also created a high level of excitement with kids, and an increase in math scores with schools that are participating in the team's project.

I want to leave you with a kind of a joke that we use in education. We used to say in telecommunications that teachers will learn how to use telecommunications when they have to download their paycheck. Well, we are far beyond the download-the-paycheck stage.

PREPARED STATEMENT

Our concern now is: Will we have children who are technologically literate to keep our Nation economically viable so we have a paycheck to download?

Senator COCHRAN. Very good. Thank you very much for your interesting and excellent statement.

[The statement follows:]

STATEMENT OF MARGARET KELLY

Mr. Chairman and Members of the Subcommittee. thank vou for the opportunity to contribute to vour examination of the appropriate federal role in funding the integration of technology into educational opportunities for K-12 students.

I am Peggy Kelly. president of the International Society for Technology in Education. based in Eugene. Oregon. ISTE a professional association of individuals and state level affiliate organizations representing in excess of 45,000 educators interested in appropriate uses of technology in the teaching/learning process. I also come to you as an educator with 16 years experience in classroom teaching from kindergarten to the 8th grade level, and as a teacher educator from California State University San Marcos campus located in northern San Diego County. I am a full professor teaching mathematics methods and educational computing to preservice teachers in collaboration with 4 public schools. And I come to you also as a very concerned parent.

On behalf of the children and educators I compliment you on your strong support for educational technology and your realistic view that a national investment in technology is not only an investment in our personal and educational future but also an investment in the economic viability of our nation.

As educators involved in using technologies to support local. state and national school reform efforts. we are concerned that the federal government continue to provide national leadership and maintain a role in supporting educational technology research and development. technology training for teachers. and effective projects that demonstrate applications of technology to improve teaching and learning.

Does technology have educational benefits?

Here is an actual situation that might help you understand the impact of your support for technology at the federal level and the educational benefits from a perspective of a learner.

My daughter's third grade class was studying astronomy and space travel. Each student selected a topic they wanted to study in depth for an independent assignment. Melissa selected 'space food.' The only problem was that the encyclopedias in the school library each had one sentence of information -- "Astronauts eat freeze dried food." She was distraught that there was no additional current information available in the public library that wasn't already checked out by someone else. She asked me if there was any information on my computer on space food. I coached her onto NASA Spacelink were she explored through the menus looking for information. She found several tidbits of information but was not satisfied. When logging off of Spacelink, there is a question posed, "Do you have any questions of NASA?" Wherein, Melissa typed her unanswered questions. This was at 9 PM on a Wednesday night.

Melissa logged back on at 6:30 AM just to see if there has been any response. She was shocked to find a nice set of leading questions from the system monitor coaching her back into Spacelink to find additional information. She discovered a the name of a local company that manufactured some of the freeze dried food for the space programs, complete with address and phone number. Sporting printout. Melissa took the information to school to share.... where the teacher doesn't even have a phone line in her classroom.

Technology provided the motivation, the active learning environment, and the opportunity for access to specific current information, regardless of race, gender, national original, or disability. Information resources such as NASA's Spacelink are not possible without leadership at the federal level.

What is the effect of technology on the schooling and learning? Is it changing the learning environment and increasing opportunities for critical thinking? Well, of course. This story underscores the reform that is taking place in the school environment, albeit much after the business world. Students need to become critical users of information resources. As you know, it is no longer acceptable to merely regurgitate facts. Students, all citizens, must be able to have access to information and critically select information that solves problems.

Investment in Innovation - Cost Effectiveness

To quote from the Request for Proposals for the National Technology Challenge Grant Program:

"The potential for creating a new generation of interactive learning environments grows out of advances in technology and telecommunications that have given us dramatic new ways to communicate complex ideas. We learn more when we are actively solving challenging problems and testing our skills in meaningful contexts, rather than through passive listening or watching in the abstract. In these new learning environments the teacher becomes a leader in the community of active learners that includes students, parents, other educators, and a broad spectrum of information resources. It is possible for learners of all ages to connect with these new learning communities in their schools, homes, or workplaces at any hour of the day. In these virtual learning communities, the extent of learning and the effectiveness of teaching need no longer be limited by the amount of time in the classroom or the resources of a particular school.

"As catalysts for change, challenge grants supports communities of educators, parents, industry partners, and others who are working to transform their factory era schools into information age learning centers. Challenge grants will support the development and innovative use of technology and new learning content in specific communities..."

The notion of the National Technology Challenge Grants, the creation of models for examination and celebration, is a cost effective way for state level decision-makers to examine possibilities and make wise decisions on how to plan effectively to meet state and local needs. Each state, each municipality, should not utilize tax dollars to investigate a variety of models for effective use of technology. The redundancy is what we are all trying to eliminate. We can all learn from the implementation of good ideas... both in terms of what worked as well as analysis of what didn't work. This saves time and dollars in planning and implementation.

Teachers don't have time to do these things alone. Districts don't have resources to engage an experimentation that duplicates what another group is doing. The federal role is to facilitate collaboration and planning.

Facilitating Planning and Funding

As the forerunners of the use of technology in education, Californians have learned, often the hard way, about the appropriate planning for educational technology. There is ample data available through the California Department of Education, Far West Labs, and

articles in ISTE's *Computing Teacher* to attest to the positive affects of appropriately planning for the implementation of technology.

The coordination of state level plans, the facilitation of states working with one another to avoid duplication of efforts (and errors). synergism of ideas. and appropriate use of taxpayer dollars is consistent with effective planning strategies. It is clearly the role of the federal government to effect that coordination and sharing among the states.

The critical components needing support are:

1. The creation of a national plan which represents the consensus among the stakeholders in educational technology --- thereby providing a direction for the creative energy in the field; and

2. The completion of a study of exploring funding alternatives for the support of the technology infrastructure.

It is obvious that federal government is the only entity able to do a credible. objective job of facilitating these efforts.

Are national projects effective? TEAMS

Another hat I wear is working with the Star Schools project out of Los Angles County Office of Education. It is commonly known as the TEAMS project, a distance learning project that impacts well over 100.000 students nation-wide. TEAMS is an example of where federal funding has nation-wide impact on students and teachers and is a cost effective use of the technology as a teaching tool. This example of a federally funded project does not use the boring TV talking head but takes advantage of live interactive telecasts coupled with telecommunications. telephone. and fax to create a hemispheric classroom in mathematics and science. What we have learned is that the use of the technology not only has increased academic performance but has also increased student motivation. improved attendance. confidence in learning.'and played a large role in the professional development of teachers who otherwise may not have had access to

consistent modeling and coaching. We all talk about educational reform. This is a project that is implementing reform at the classroom level....with kids....where it counts....all across America.

Technology Guidelines, Assistance, and Training

Technology Guidelines - As an extension of the necessity for planning. it is also appropriate for the federal government to encourage and support the development of a set of standards or guidelines for what student should know and be able to do with technology. what constitutes appropriate uses of technology. necessary levels of support (in the broadest definition of the term) to enhance the implementation of integrating technology as a tool for teaching and learning throughout the curriculum.

ISTE has played a critical role in the development of technology standards used in the NCATE accreditation process for Colleges of Education. ISTE has begun the work on identifying guidelines for students' use technology.

Technology Assistance - From a teacher perspective. the establishment of regional support centers is an appropriate federal role. Teachers. parents. the collective educational community need the availability of technical assistance both for the dissemination of appropriate practice and a place to answer questions of "how can I...." Support services on a regional level have already been established as a cost effective model of providing high quality service.

Teacher Training - The Eisenhower program has been an exceptionally effective program in mathematics and science I have been involved in Eisenhower funded programs both as a participant and a project director at the state level. As a teacher. I urge your continued support for Eisenhower funds for use of training opportunities that utilize technology in the context of teaching and learning. We will never know all there is to know about technology. teaching and learning. But we do need to know what is the best thinking of the time and how to

effectively use the most effective learning tools. And like every citizen, teachers need to continuously have the opportunity to be learners.

Conclusion

We used to joke that people would learn how to use telecommunications when they had to download their paycheck. That is no longer the case. Educators are clamoring for telecommunications, among other technologies, as a way to provide interactive information resources for their students that make learning meaningful and alive. Over time, from an economic perspective we have gained the ability to download our paychecks. The real question is whether or not the federal government will continue to take a proactive stance in supporting the development of a technologically rich environment so our students can maintain the competitive edge for our nation so that we have a paycheck to download.

STATEMENT OF JEANNE HAYES, PRESIDENT, QUALITY EDUCATION DATA, DENVER, CO

Senator COCHRAN. Dr. Jeanne Hayes, you may proceed.

Dr. HAYES. Thank you, Senator Cochran, Senator Jeffords, and the rest of the subcommittee.

I am very honored to be here today to present some of the actual facts and the numbers that were asked for earlier that may reflect some of the information that will help us make some decisions.

I know earlier, Senator Jeffords said, how can we start, if, in fact, we have such an overwhelming need, and numbers of $15 billion as an investment are discussed, how can we start in a time of budget cuts and of an attempt to restore ourselves of the frugality for which we are famous.

Here are some of the possible answers. If we start with the questions of equity themselves, it may seem evident to those who are not involved with education that students of lower income would be less likely to have access to computers.

But those in this room know, in fact, that chapter 1 and other funding from Federal, State, and local sources has been used to a great degree to purchase technology. So it is not with pleasure that I inform you today that in the current school year, if one were to look at students per computer, we have good news and bad news.

The good news is, first of all, since 1983, 1984, when we began tracking this, at that time, the number of students per computer was 125 to 1. If you want to imagine all of the people in this room all clustered around one computer, you are probably close to the situation in 1983.

If we look at today, on the other hand, we are looking at fewer than 12 students per computer, a huge leap in 12 years. On the

other hand, imagine yourself with 11 others in this room working daily at your instruction. It is still not satisfactory.

Linda Roberts and others in this room have suggested a number around five, having some instructional value of buddying, but we are still not there, and that is, I am sure, the investment to which Senator Jeffords referred.

If we go on and look at the differences, however, we now know we have a benchmark, that this year there are 12 students per computer. But if we look at three pieces, we will see that that is not the case for all segments of our society.

In the first place, the student who is in a school where there is a higher percentage of chapter 1 students, that is students who qualify for compensatory education, because of low income in his family, is more likely to be in a school that has 14 students per computer, or two points above the average. That is the first step.

We then look also at students of color, and determine the typical array of computers in that school, and we will find that it is even worse. Again, it is 14 to 1 in a school with a high percentage of multicultural students.

And third, in the fastest growing segment of our population, that is, Hispanic students, have even less access. There it is 17 students to 1, and that is, again, almost half again as much as in the average classroom. Those numbers are not encouraging in terms of issues of equity in access, which we are all discussing today.

There are some ways, however, that we could make some real steps. We looked into the data base of schools in this country and said, where are the worst cases.

And we said, those are beyond the scope of this committee, and of the issues that we can address today, but perhaps we can look at the districts that have what we call greatest need.

Out of the 15,000 school districts in the United States, about 1,000, which represents about 10 percent of all students and schools, have twice the national average of number of students per computer.

Rather than 12 students per computer, these are districts that have 23 or more students per computer. We are back to clustering around the table again, in terms of how much access they can get.

If we accept the fact that these are the districts that have the greatest need, we know that a computer is not the answer to all our technologies. Certainly, the Mathline is showing us many telecommunications and other aspects.

But if we want to look at a simple measure from which many other technologies continue, it is, in fact, that computer that is the foundation. It may be old. Several people here have mentioned antiquated equipment.

We also can look at that in terms of the age of the equipment, but right now we are just saying the sheer numbers. Let us look at those districts that have a 23-to-1 student to computer ratio.

If we were to invest in those districts, we could say that a computer costs $2,000 apiece, and we could say that with an investment, we would find that, surprisingly enough, the States that have the greatest need—if we simply took the number of computers needed to meet the national average in these 1,000 districts, we would go on and say the State that has the greatest need is not

in Mississippi, it is not in Vermont, it is, in fact, in California, of the national investment that we would need to address these districts, 26 percent of that investment is in the State of California.

If we kept going, we would say that the next two States are Illinois and Tennessee, not the States that would come to mind as those needing technology.

What we are looking at truly is the case of rural students, inner-city students, districts in perhaps affluent or less affluent communities, but across this country. Continuing on, we are looking at adding Ohio and Pennsylvania. We are looking at Louisiana and Massachusetts.

Continuing on, we have now gotten to approximately 50 percent of the national investment, 64 percent, I believe. We continue on to another six States that have the next substantial grouping.

I believe that is including Connecticut, New Jersey, and perhaps five other States that are shown in my testimony. Those are the critical issues. We have another 22 States that have a relative involvement here.

PREPARED STATEMENT

In 43 States there are cases where we have that lack of access to technology, and that is a small proposal that I would suggest for your consideration. Thank you.

Senator COCHRAN. Thank you for that very interesting presentation, Dr. Hayes.

[The statement follows:]

STATEMENT OF JEANNE A. HAYES

Quality Education Data, Inc.[1]

Executive Summary

- All students do not have equal access to technology in U.S. public schools.
- All U.S. public schools: 12: 1
- Schools with high percentage of Chapter 1 students: 14: 1
-
- Schools with high percentage of Hispanic students: 17: 1
- Schools with "greatest technology need":   23: 1 or higher
- Schools with the "greatest technology need" range from rural schools to small-town America to large metropolitan areas.
- Schools with "greatest technology need" are found in 43 of the 50 states.
- Schools with the "greatest technology need" are in California, Tennessee, Illinois, Pennsylvania, Ohio, Texas, Louisiana and New Jersey, accounting for 64% of the total computers needed to bring "greatest technology need" districts up to the national average.
- An investment of slightly more than $400 million would bring the bottom 10% of districts and their students up to the national average of students per computer.

[1] Quality Education Data is an education research firm located in Denver, Colorado, and a division of Peterson's. Princeton, New Jersey. The QED National Education Database is a dynamic repository for information about U.S. and Canadian schools, including enrollment, technology, student and community characteristics. For the past 14 years, the database has included current-year annual data for the universe of 15,000 school districts and 84,000 public schools, as well as findings from sample surveys for the past seven years of large and medium districts for trend-setting districts.

Equality and Technology

The goal of equality has long been an issue in American education. As a nation, we have looked at "separate but equal" systems and decided they were, indeed, not equal. Today, as our society increasingly becomes dependent on technology--even most entry-level jobs require some basic knowledge of computers--the equality debate now centers on access to educational technologies.

Do all public school students have equal access to educational technologies? To answer this question, we must first look at the educational technologies available to the average student.

Educational Technologies-- The National Perspective

Overall student access to personal computers has improved dramatically during the past 12 years. During the 1983-84 school year, when the first such data were collected, the nation-wide average was 125 students for each computer. By 1988-89, this ratio had improved to 22:1 Today, the national average is 12:1. [1]

Students per Computer

12-Year Trend
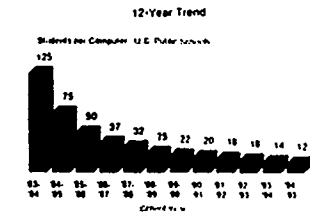
While computers are the foundation for student use of multimedia and other technologies, a look at the growth of new technologies also gives us a national perspective against which to compare.

Cable television is by far the most common educational technology available to students. During the 1992-93 school year, 60% of all public school districts and 58% of all school buildings were wired for cable. By 1994-95, these figures had increased to 67% and 73% respectively. [2]

Not all schools are located in communities that have cable television outlets. This is often the case in rural districts. In these instances, satellite dishes are often installed to allow schools access to in-service training broadcasts for teachers and administrators, and for-credit foreign language, science, mathematics and other courses for students. The percentage of satellite-owning districts increased from 33% in 1992-93 to 38% in 1994-95. At the school level, satellite dish ownership increased from 11% to 16%, with satellite dishes more often located at high schools than at elementary schools.

New Technology Growth

Public school districts are also increasingly connecting their personal computers in local area networks (LANs). [3] In 1994-95, 49% of districts reported owning LAN connections, up from 35% in 1992-93. At the building level, the number of LAN-owning schools increased from 14% in 1992-93 to 27% in 1994-95.

Modem ownership saw similar increases over the three-year period, growing from 34% in 1992-93 to 45% in 1994-95 at the district level, and from 22% to 33% at the school level. [4]

New Technologies

3-Year District Trends
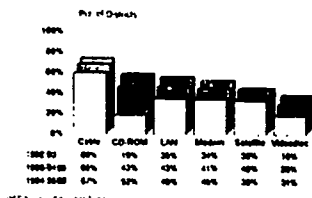
CD-ROM was the fastest growing educational technology during the three-year period, starting out at 19% at the district-level in 1992-93, and growing to 52% in 1994-95, an astounding 273% growth rate. At the individual building level, the number of CD-ROM-owning schools has grown from 13% to 37%, lagging behind overall district ownership as CD-ROMs are placed more often in high schools than in elementary schools. [5]

Ownership of videodisc players has also seen strong growth in the past three years, from 18% to 31% at the district level, and from 14% to 26% at the school level. [6]

New Technologies

3-Year School Trends
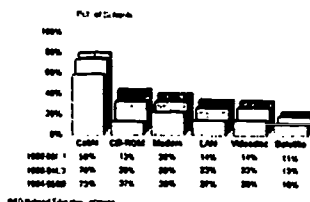
Relative Wealth and Access to Educational Technologies

Access to computers is seriously affected by the relative wealth of the school's student population.

"Chapter 1" (recently re-named Title I) students are those who qualify for compensatory education funds because of low family income (below the poverty level). Schools with 26% or more of the total student population qualified as Chapter 1-eligible are labeled "low" wealth schools, while those with 11-25% are "medium," and schools with 10% or less are "high" wealth schools. [7]

If we look at access to personal computers only by income levels, students in schools with the lowest percentage of Chapter 1 students (10% or fewer) have the best ratio of students per computer at 11.7:1. Students at medium-wealth schools (11-25% Chapter 1 qualifying students) still have high access to computers at 11.9:1.

As the percentage of Chapter 1-qualifying students increases, however, individual student access to personal computers declines rapidly to 13.9:1 for schools with 26% or more Chapter 1 qualifying students, well below the national average.[8]

Poor Students Have Reduced Access

School Average Students per Computer

11.7   11.7   11.9   12.8   13.9

Highest Income   Lowest Income
School Concentration of Students Qualifying for Chapter 1 Funds
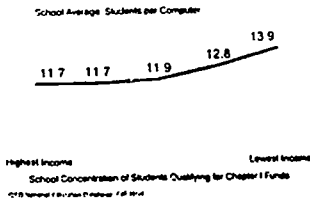
As poverty levels increase, access to other educational technologies decreases. While 73% of students in all schools have access to cable television, the percentage of cable-ready schools decreases as poverty levels rise. Students in "low" wealth schools (more than 26% Chapter 1-eligible students) have significantly less access at 66%.[9]

School-level ownership of LANs also decreases as poverty increases, reaching just 20% in "low" wealth schools, compared to the national average of 27%.[10]

While 33% of all public schools own modems, only 27% of "low" wealth schools reported modem ownership.[11]

Nationwide, 37% of schools own CD-ROMs. CD-ROM ownership drops to 25%, however, among "low" wealth schools.[12]

School technology is funded by a variety of sources, including local, state, and federal funding. Chapter 1 is the largest federal funding source with more than $8 billion disbursed annually to schools that qualify. Chapter 1 funding is intended to compensate underprivileged children through improved instruction, and many schools use Chapter 1 funding to purchase technology.[13] In fact, almost one-third of all software and hardware used primarily for basic skills instruction in schools was financed by Chapter 1 funds, about $400 million during the 1993-94 school year.[14] However, it appears that Chapter 1 funding is not enough to bridge the gap between rich and poor.

Ethnicity and Access to Educational Technologies

How does ethnicity affect access to computers? To answer this question, we have combined ethnic composition information about each school's student population with QED's technology information.

Schools with 50% or more African-American, Hispanic, Native American, and/or Asian students have "high" multicultural student populations. Schools with "medium" ratings have 21-49% non-White student populations. Schools with "low" ratings have 1-20% non-White student populations. "No" multicultural schools have no non-White students.

As with poor students, students in schools with high percentages of multicultural students have less access to computers. This is not surprising, because percentages of Chapter 1 students and percentages of multicultural students are positively correlated in public schools. However, the disparity between "high" and "low" multicultural percentages is greater than the disparity between "poor" and "rich" schools.[15]

In general, the more ethnically diverse a school's population, the less access individual students have to personal computers. While the national average is one computer for every 12 students, schools with low multicultural ratings average 1:11.9. While the number of schools with an extremely high multicultural student percentage is small, the findings are still of concern. Student access decreases as the ethnic mix of the school increases. Schools with "high" multicultural ratings (those with 50% or more non-White students) have the lowest of ratios at 1:13.9.[16]

Students of Color Have Less Access
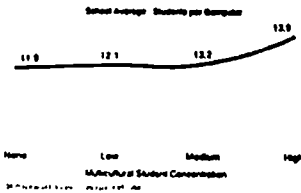
Combining QED data with National Center for Education Statistics data, we can also track the number of students per computer by specific ethnic group. For African-Americans, the average number of computers

per student is below the national average at 1:13 in schools with 50% or more African-American students.[17]

African-American Students Have Less Access
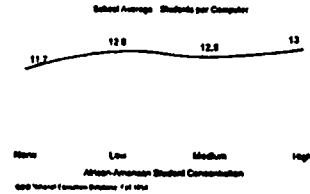
Schools with high concentrations of Hispanic students have even fewer computers, reaching a low of one computer for every 17 students among schools with 50% or more Hispanic students.[18]

Hispanic Students Have Least Access
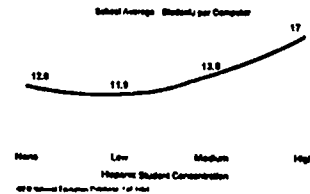
The ethnic make-up of a school's student population also has a high impact on access to other educational technologies.

Schools with "high" multicultural populations have less access to cable television (68%) than the national average (73%).[19]

Satellite ownership reaches its highest levels at 17% among schools with "low" multicultural student populations, and is at its lowest at 10% among schools with "high" multicultural ratings.[20]

LAN ownership is highest among "low" multicultural schools at 26%, and drops to 19% among "high" multicultural schools.[21]

While 37% of all schools own CD-ROMs, this percentage drops to 29% among "medium" multicultural schools, and 26% among schools with "high" multicultural ratings.[22]

For two technologies, Modem use and Interactive Videodisc, these equity issues are not as apparent and do not apply. This would be great news for student access to online services, except that the Internet is found by another QED study to be more common in affluent communities than in communities with students below the poverty level.[23]

Limited Access Means Less Constructive Learning

When computers were first introduced in our schools, they were "clustered" in central computer labs. Students took turns using the equipment on a class by class basis. As new computers were added, along with modems, CD-ROM drives and videodisc players, the technology began to spread into libraries and other learning centers, and the use of LANs started to increase.

As the installed base continues to grow, computers and other technologies are moving into the classroom. Here students learn firsthand how a computer with a modem and a telephone connection can lead them to a wealth of resources and information far beyond the school's walls, or enroll in distance learning courses via satellite that would otherwise not be available at their school.

While many of our children work in teams of two or three on one computer to complete class assignments, conduct research, and prepare multimedia presentations of their findings, students in schools with high concentrations of poverty-level students, or schools with high percentages of multicultural students, must limit the time students spend using computers. As a result, these students leave school less prepared than their counterparts at better equipped schools.

Studies by the Software Publishers Association[24] and others have shown the effectiveness of educational technologies in a variety of curriculum areas, from math and science, to vocational education and reading. And regardless of academic level, educational technologies have proven effective in programs ranging from special education to gifted-and-talented.

If our students are to perform well in an increasingly knowledge-based society, technology equity is needed for all students, regardless of income or ethnic background.

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Schools With The Greatest Need

The average district has one computer for every 12 students. Those districts with one computer for every 23 students should be helped first. This group includes 1,179 districts with more than 7,000 schools, and more than four million students in 43 states, or about 10% of all schools and 9% of all students.

Included are schools of all types and sizes in urban, suburban and rural areas, schools with both "high" and "low" multicultural ratings, and both rich and poor schools.

For example, a school district in the Rocky Mountain region, located in the largest city in a sparsely-populated state, has only one computer for every 22 students, one of the lowest ratios nationwide. Yet the district has none of the usual technology-poor indicators. The district has a low multicultural rating with fewer than 9% non-White students (1% African-American, 4% Hispanic, 5% Native American, and 1% Asian). The high school is a "medium" wealth school with 19% of the students rated as Chapter 1-eligible, only slightly higher than the national average of 15%. A school-business partnership has been formed at the school.[25]

Another district with the greatest need, however, has schools with both high percentages of poverty-level students and high percentages of multicultural students. A big-city school district in the mid-Atlantic states has only one computer for every 28 students, one of the worst ratios of any district in the country. Not surprisingly, more than 80% of the district's students are African-American,

and 61% of the district's students are Chapter 1-eligible based on family incomes.[26]

Are We Willing to Invest in Quality Access for Future Employment?

"Employers Vote No Confidence in Nation's Schools" A February 20, 1995 article in the *New York Times* cites a Census Bureau report that employers doubt our schools' ability to prepare students for the workplace.[27] If technology access and experience are part of the answer to empowering our students for future employability, then an investment in schools with twice the national average number of students per computer is a small price to pay.

Paraphrasing Shakespeare: to be equal or not to be equal, that is the question. Clearly, we have not been successful in achieving technology equity for all students. The districts with 'greatest need' can be brought up to the level of the U.S. average for a surprisingly small investment, as shown on the attached listing.

Footnotes

1   QED's *Technology in Public Schools, 1994-95*
2   Ibid.
3   With a local area network (LAN), multiple computers are connected via
    telecommunications devices in a single building or complex of buildings to
    form a network of small geographic scope.
4   A modem is a device that translates digital computer signals into analog form, and
    vice versa, for transmission through a telecommunications medium such as a
    telephone line.
5   A Compact Disk/Read-only Memory (CD-ROM) is an optical disk system that holds far
    more information than a standard computer floppy disk.
6   A videodisc holds more information than a CD-ROM, allowing for extensive use of video
    segments. Some videodisc players have bar code readers, which enable users to move
    quickly from one segment of the videodisc to another.
7   QED's National Education Database includes data from the National Center for Educa
    tion Statistics (NCES) which gathers this information from State Departments of Educa-
    tion for all public schools.
8   QED National Education Database, Fall 1994
9   Ibid.
10 Ibid.
11 Ibid.
12 Ibid.
13 Education TURNKEY Systems, Inc., 1994
14 Ibid.
15 QED's *Technology in Public Schools, 1994-95*
16 QED National Education Database, Fall 1994
17 Ibid.
18 Ibid.
19 QED's *Technology in Public Schools, 1994-95*
20 Ibid.
21 Ibid.
22 Ibid.
23 Ibid.
24 Software Publishers Association's Effectiveness of Technology Report, 1994
25 QED National Education Database, 1994-95 School Year
26 Ibid.
27 Census Bureau findings, *New York Times*, February 20, 1995

Toward Defining the "Greatest Need for Educational Technology"

"Improving America's Schools" is the title and the major objective of Congress' new legislation for elementary and secondary education in the United States. Several educational technology programs are included in Title III of this legislation, with $27 million appropriated for the new competitive grant program, "National Challenge Grants for Technology in Education."

When awarding these National Challenge Grants, the Secretary of Education is required to give "first priority" to proposals from consortia that include at least one local education agency that has a "...high number or percentage of disadvantaged students or the greatest need for educational technology."

Potential consortia partners can easily locate local education agencies with "a high number or percentage of disadvantaged students." The definition of "disadvantaged" and lists of these agencies are maintained in both Federal and State education offices. Lists of local education agencies with "the greatest need for educational technology," however, are not readily available since these terms have not been previously defined as a basis for list creation.

A Definition--Greatest Need for Educational Technology

This report assumes the "greatest need for educational technology" should be based on objective criteria, such as the availability--or lack of availability--of educational technology resources. Therefore, schools with the "fewest educational technology resources" would have the "greatest need for educational technology."

There are some education agencies with few resources and no "perceived need" to acquire more. However, those agencies applying for Challenge Grants that have the "lowest" levels of resources should be considered as those with the "greatest" need.

Criterion for Defining Need

The number of personal computers in schools has been closely monitored during the past decade and most often reported as a ratio of the number of students per computer. Generally speaking, schools with poor "students per computer" ratios also have limited access to other modern learning technologies, such as telecommunications, cable in the classroom, and multimedia. Therefore, the students per computer ratio is a good basic criterion that can be used to identify local education agencies that have the "greatest need for educational technology."

Students per Computer

As depicted below, student access to personal computers has improved dramatically during the past 12 years. During the 1983-84 school year, when the first such data were collected, the nationwide average was 125 students per computer (125:1). By 1988-89, this ratio had improved to 22:1. Today, the national average is 12:1.

Students per Computer

12-Year Trend

Students per Computer: U.S. Public Schools

QED National Education Database
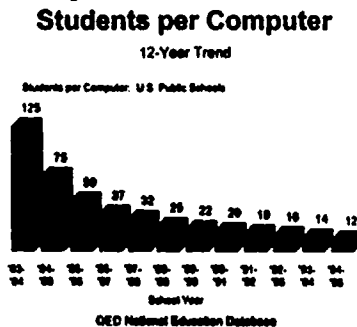
Unfortunately, not all students have equal access to personal computers. If we look at all U.S. public school districts by the numbers of students per computer, we can clearly identify those schools that have the fewest resources per student and, therefore, those with the "greatest need for educational technology." The educational agencies with the "greatest need" are defined in this report as those with more than twice the national average of 11.8 students per computer (11.8:1), or those districts with ratios of 23:1 or greater.

U.S. Total for Students and Computers in K-12 Public Schools

		Number of				Students
	Students per Computer Ratio	Districts	Students	Schools	Computers	per Computer
	Less than 5·1 Ratio	1,178	1,155,783	3,433	296,511	3.9
	5-12.4.1 Ratio	6,745	18,059,370	36,256	2,023,416	8.9
	12.5-23:1 Ratio	5,127	20,093,580	35,355	1,216,740	16.5
"Greatest Need"	23:1 Ratio or Greater	1,179	4,363,195	7,703	152,943	28.5
	Total*	14,229	43,671,928	82,747	3,689,610	11.8
	* Districts include only Local Education Agencies (LEAs) and do not include supervisory unions,					
	intermediate units, or subdistricts Schools do not include 1,1414 schools in intermediate units					

QED National Education Database, 1994-95 Beginning School Year

School Districts with the Greatest Need

Using the recommended definition of school districts with the "fewest" educational technology resources, and the "students per computer" ratio as the suggested criterion, following is a list of U.S. school districts that have the "greatest need for educational technology." This list is organized by Number of Students per Computer in descending order within state.

Greatest Need by State

The attached listing reveals the states of California, Illinois, Tennessee, Ohio, and Pennsylvania have large numbers of students in districts in the "greatest need" category. This reflects the surprising finding that districts with the "greatest need" are located in all but seven states and are at about the national average both in percentage of Chapter I students and of Multicultural students. These districts reflect students in schools suffering from "technology poverty," a serious threat for a nation whose workplace has already made the paradigm shift to a technology environment.

Encl.: "Districts with Greatest Need for Instructional Computers by State"
State Summary of All Districts and "Districts with Greatest Need"
State Summary of Investment Needed to Bring "Greatest Need' districts up to National Average

Districts with "Greatest Need for Educational Technology"
By State
Prepared by Quality Education Data, Inc.
March 28, 1995

ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
AK	Kashunamiut School District	29.9	209	7	1	127	61%	205	98%
AK	Total		209	7	1	127		205	
AL	Elmore County School District	53.9	8,618	160	12	2,068	24%	2,758	32%
AL	Autauga County School District	34.6	7,500	217	11	1,500	20%	2,025	27%
AL	Jasper City School District	31.5	2,997	95	6	599	20%	629	21%
AL	Walker County School District	31.4	9,309	296	23	1,676	18%	745	8%
AL	St Clair County School Dist	30.9	6,372	206	12	1,211	19%	701	11%
AL	Franklin County School Dist	29.5	3,215	109	7	579	18%	32	1%
AL	Greene County School District	28.9	2,196	76	6	1,230	56%	2,174	99%
AL	Hartselle City School Dist	28.7	2,926	102	5	439	15%	146	5%
AL	Henry County School District	28.7	2,896	101	7	840	29%	1,477	51%
AL	Perry County School District	28.3	2,969	105	7	1,663	56%	2,850	96%
AL	Dothan City School District	27.9	10,017	359	18	1,903	19%	4,207	42%
AL	Bibb County School District	27.4	3,488	127	9	908	26%	1,011	29%
AL	Blount County School District	27.3	6,244	229	11	1,061	17%	62	1%
AL	Arab City School District	26.2	2,677	102	4	187	7%	0	0%
AL	Macon County School District	26.0	4,608	177	8	1,751	38%	4,239	92%
AL	Calhoun County School District	24.9	10,988	442	17	1,538	14%	1,319	12%
AL	Geneva City School District	24.7	1,406	57	3	197	14%	239	17%
AL	Chambers County School Dist	24.4	4,005	164	11	801	20%	2,203	55%
AL	Pell City School District	23.6	3,331	141	5	0	0%	533	16%
AL	Haleyville City School Dist	23.6	2,050	87	3	369	18%	21	1%
AL	Coosa County School District	23.1	1,845	80	6	554	30%	849	46%
AL	Total		99,855	3,432	191	21,072		28,220	
AR	White Hall School District	50.0	2,900	58	7	406	14%	232	8%
AR	Sheridan Public School Dist	44.9	3,370	75	5	539	16%	67	2%
AR	Searcy Special School District	34.3	3,600	105	6	664	19%	180	5%
AR	South Conway Co. School Dist	33.5	2,645	79	6	952	36%	635	24%
AR	Evening Shade School District	31.0	310	10	1	140	45%	0	0%
AR	Stuttgart Public School Dist	28.5	2,282	80	6	867	38%	981	43%
AR	Cabot Public School District	28.3	5,793	205	9	985	17%	174	3%
AR	Harrison Public School Dist	27.7	2,850	103	6	599	21%	0	0%
AR	Benton Public School Dist 8	27.1	4,045	149	7	728	18%	283	7%
AR	Russellville School Dist 14	26.4	5,182	196	11	1,036	20%	363	7%
AR	Greenwood School District 25	26.2	2,702	103	4	324	12%	0	0%
AR	Pulaski Co. Spec School Dist	24.8	22,433	904	39	4,262	19%	6,057	27%
AR	Lonoke Public School District	24.0	1,728	72	4	570	33%	449	26%
AR	Ozark Public School Dis. 14	24.0	1,440	60	5	403	28%	14	1%
AR	Yellville-Summit School Dist	23.5	1,050	45	3	381	36%	0	0%
AR	Texarkana Arkansas School Dist	23.4	5,500	235	10	2,255	41%	2,255	41%
AR	Total		67,839	2,479	131	15,132		11,691	
AZ	Santa Cruz Valley Sch Dist 35	78.1	1,406	18	4	225	16%	996	71%
AZ	Gadsden School District 32	42.1	2,103	50	2	652	31%	2,082	99%
AZ	Oracle School District 2	39.7	595	15	2	54	9%	238	40%

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ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
AZ	Yuma Union High School Dist 70	34 7	7,138	206	3	1,428	20%	4,497	63%
AZ	Crane Elem School District 13	31 4	5,300	169	6	954	18%	2,544	48%
AZ	Santa Cruz Valley H S Dist 840	30 0	480	16	1	202	42%	427	89%
AZ	Mohave Valley Elem Sch Dist 16	28.5	1,565	55	3	141	9%	297	19%
AZ	Mohawk Valley School Dist 17	27 3	273	10	1	76	28%	150	55%
AZ	Fowler School District 45	27 1	1,355	50	2	81	6%	637	47%
AZ	Isaac Elem School District 5	26 1	6,660	255	8	866	13%	5,261	79%
AZ	Stanfield School District 24	25.0	625	25	1	200	32%	431	69%
AZ	Osborn School District 8	24.0	3,500	146	5	455	13%	1,645	47%
AZ	Duncan Unified School Dist 2	23.2	650	28	2	130	20%	143	22%
AZ Total			31,650	1,043	40	5,463		19,351	
CA	Roseland Elem School District	69.0	1,035	15	2	590	57%	538	52%
CA	Buena Vista Elem Sch District	65 0	130	2	1	77	59%	46	35%
CA	Redlands Unified School Dist	59.6	17,053	286	19	4,093	24%	7,333	43%
CA	Ocean View School District	55.1	9,040	164	15	2,079	23%	2,893	32%
CA	Hanford Elem School District	52 1	4,849	93	8	2,667	55%	2,715	56%
CA	Arcadia Unified School Dist	52.1	8,282	159	11	414	5%	4,389	53%
CA	Taft City Elem School District	51.3	2,103	41	6	883	42%	231	11%
CA	Sunnyside Un Elem Sch District	50.9	560	11	1	409	73%	347	62%
CA	Perris Elem School District	50.0	4,604	92	5	3,085	67%	3,131	68%
CA	Santa Monica-Malibu Un Dist	47.2	10,190	216	16	2,242	22%	4,687	46%
CA	Shasta Union High Sch Dist	47.1	4,470	95	4	760	17%	849	19%
CA	Lamont School District	43.8	2,800	64	4	2,520	90%	2,324	83%
CA	Berryessa Union Elem Sch Dist	43.5	8,617	198	13	1,723	20%	5,946	69%
CA	Semitropic Elem School Dist	43.5	174	4	1	164	94%	144	83%
CA	Centinela Valley Un H S Dist	42.7	6,022	141	4	602	10%	5,360	89%
CA	Calexico Unif School District	42.6	7,284	171	10	3,715	51%	7,138	98%
CA	Rincon Valley Union Elem Dist	42 5	2,719	64	7	517	19%	272	10%
CA	Newark Unified School District	42.2	6,619	157	15	1,456	22%	3,177	48%
CA	Alta Loma School District	42.0	7,852	187	9	785	10%	2,042	26%
CA	Mother Lode Un Elem Sch Dist	41.8	1,880	45	3	414	22%	150	8%
CA	West Covina Unif School Dist	41.2	8,320	202	11	2,579	31%	5,574	67%
CA	La Mesa-Spring Valley Sch Dist	41 1	14,680	357	22	1,468	10%	2,789	19%
CA	Oxnard Elem School District	40.6	12,990	320	17	9,093	70%	10,912	84%
CA	Ophir Elem School District	40.2	241	6	1	17	7%	12	5%
CA	Morongo Unif School District	40 2	10,160	253	16	3,861	38%	2,235	22%
CA	Roseville Jt High School Dist	40 0	4,683	117	6	234	5%	749	16%
CA	Woodville Elementary Sch Dist	40 0	680	17	1	598	88%	612	90%
CA	Woodlake Union High Sch Dist	40 0	800	20	2	368	46%	528	66%
CA	Inglewood Unif School District	39 8	16,328	410	19	9,307	57%	16,001	98%
CA	San Ysidro Elem School Dist	39 2	3,880	99	6	3,531	91%	3,725	96%
CA	Pleasant View Elem School Dist	18 4	461	12	1	392	85%	300	65%
CA	Kingsburg Jt Un High Sch Dist	36 3	880	23	2	238	27%	414	47%
CA	Livingston Union School Dist	38 2	2,252	59	3	1,734	77%	1,914	85%

SI	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
CA	Salinas City Elem Sch District	38.1	8,200	215	13	4,428	54%	5,494	67%
CA	Sequoia Union Elem School Dist	37.7	377	10	1	185	49%	117	31%
CA	Waterford Elementary Sch Dist	37.5	1,311	35	2	721	55%	406	31%
CA	Magnolia Elem School District	37.4	5,528	148	8	3,040	55%	3,040	55%
CA	Penryn Elem School District	37.2	335	9	1	34	10%	40	12%
CA	Mariposa Co Unif School Dist	37.0	2,699	73	12	540	20%	297	11%
CA	Vineland School District	36.3	726	20	2	632	87%	661	91%
CA	San Marcos Unif Sch District	36.2	10,139	280	10	4,157	41%	4,056	40%
CA	Paramount Unif School District	36.1	13,900	385	15	5,143	37%	12,371	89%
CA	Pond Union School District	36.0	180	5	1	124	69%	85	47%
CA	Rosemead School District	36.0	3,056	85	5	1,895	62%	2,659	87%
CA	Kingsburg Jt Un Elem Sch Dist	35.9	1,832	51	4	696	38%	843	46%
CA	Los Gatos Union Sch Dist	35.1	2,459	70	5	98	4%	344	14%
CA	Fairfax Elem School District	34.5	1,208	35	2	894	74%	737	61%
CA	Le Grand Un Elem School Dist	34.5	448	13	1	287	64%	323	72%
CA	Menlo Park City Elem Sch Dist	34.4	1,617	47	4	65	4%	340	21%
CA	Rescue Union School District	34.4	2,750	80	5	220	8%	275	10%
CA	Tulare City Elem School Dist	34.3	7,075	206	11	4,316	61%	3,962	56%
CA	Riverbank Elem School District	34.3	1,957	57	4	959	49%	1,018	52%
CA	William S Hart Un H S District	34.1	11,290	331	11	452	4%	2,484	22%
CA	Healdsburg Union Elem Sch Dist	34.0	1,225	36	3	355	29%	355	29%
CA	Sierra Sands Unif School Dist	33.6	7,324	218	14	1,611	22%	1,318	18%
CA	Desert Sands Unif Sch District	33.4	18,460	552	21	7,384	40%	11,261	61%
CA	Redwood City Elem School Dist	33.2	8,271	249	15	3,391	41%	4,963	60%
CA	Jefferson School District	33.0	7,000	212	15	3,010	43%	5,950	85%
CA	Sundale Union Elem Sch Dist	32.6	424	13	1	199	47%	170	40%
CA	Vacaville Unif School District	32.6	13,449	413	20	3,228	24%	3,362	25%
CA	Anaheim City Elem Sch District	32.5	15,742	484	21	6,612	42%	11,177	71%
CA	Escalon Unified School Dist	32.1	2,569	80	8	642	25%	591	23%
CA	Live Oak Elem School District	32.0	2,083	65	3	750	36%	542	26%
CA	Sunnyvale Elem School District	31.9	6,246	196	9	1,811	29%	3,685	59%
CA	Millbrae Elem School District	31.8	2,292	72	5	390	17%	1,077	47%
CA	Coachella Valley Unif Sch Dist	31.8	9,314	293	13	6,520	70%	8,755	94%
CA	Meadows Union Elem School Dist	31.7	539	17	1	372	69%	420	78%
CA	Lammersville Elem School Dist	31.7	285	9	1	74	26%	57	20%
CA	Palmdale Elem School District	31.7	17,600	556	18	5,632	32%	6,864	39%
CA	Natomas Unified School Drst	31.5	2,898	92	5	782	27%	1,391	48%
CA	Lassen Union High School Drst	31.4	1,100	35	2	77	7%	154	14%
CA	Riverdale Jt Union Elem Dist	31.4	816	26	2	530	65%	432	53%
CA	Madera Unified School Dist	31.3	15,020	480	20	5,708	38%	9,312	62%
CA	Bonita Unif School District	31.2	9,819	315	13	2,062	21%	3,437	35%
CA	King City Joint Un H S Drst	31.0	1,335	43	2	120	9%	961	72%
CA	Lodi Unified School District	31.0	25,325	817	38	9,624	38%	11,396	45%
CA	Duarte Unified School District	30.6	4,499	147	8	2,294	51%	3,419	76%

SI	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
CA	Lafayette Elem School District	30.8	3,058	100	5	92	3%	336	11%
CA	Summerville Union H S District	30.5	641	21	5	115	18%	58	9%
CA	Old Adobe Union School L 'st	30.3	2,275	75	4	250	11%	387	17%
CA	Montebello Unif School Dist	30.2	31,838	1,053	31	13,689	43%	29,607	93%
CA	Heber Elem School District	30.0	800	20	2	552	92%	588	98%
CA	Stone Corral Elem Sch District	30.0	150	5	1	84	56%	141	94%
CA	Vallecito Union Elem Sch Dist	30.0	1,200	40	3	300	25%	144	12%
CA	El Dorado Union H S District	30.0	4,950	165	6	248	5%	396	8%
CA	Lake Elementary School Dist	30.0	120	4	1	41	34%	14	12%
CA	Napa Valley Unif School Dist	29.9	14,624	489	27	3,510	24%	3,510	24%
CA	Harmony Union School District	29.7	593	20	2	77	13%	77	13%
CA	Pittsburg Unif School District	29.8	8,901	301	13	4,094	46%	6,142	69%
CA	Salida Union School District	29.4	2,000	68	3	600	30%	720	36%
CA	San Lorenzo Vly Unif Sch Dist	29.2	4,000	137	7	520	13%	320	8%
CA	Oakley Union Elem School Dist	29.2	3,765	129	5	264	7%	715	19%
CA	Hughes-Elizabeth Lakes Un Dist	29.1	465	16	1	84	18%	28	6%
CA	Elverta Joint Elem School Dist	29.1	465	16	2	144	31%	60	13%
CA	Salinas Union High School Dist	29.1	8,573	295	8	3,066	36%	8,258	73%
CA	Hayward Unif School District	28.8	20,811	715	37	7,832	38%	13,397	65%
CA	Santa Rosa City School Dist	28.7	16,395	571	22	4,099	25%	4,591	28%
CA	Lawndale School District	28.6	4,439	155	7	2,530	57%	3,063	69%
CA	Santa Rita Un School Dist	28.5	2,135	75	3	897	42%	1,236	58%
CA	Willits Unified School Dist	28.2	2,542	90	9	330	13%	458	18%
CA	Westmorland Union School Dist	28.1	506	18	1	435	86%	430	85%
CA	Glendale Unified School Dist	27.9	28,285	1,014	28	11,880	42%	11,597	41%
CA	Richland-Lerdo Elem Sch Dist	27.9	2,563	92	4	1,743	68%	1,717	67%
CA	Windsor Union School District	27.7	2,550	92	4	765	30%	791	31%
CA	Alameda Unif School District	27.6	9,928	360	19	2,085	21%	5,262	53%
CA	Paso Robles Union Elem Dist	27.5	3,990	145	6	996	25%	1,077	27%
CA	Mountain View Elem School Dist	27.5	2,750	100	4	385	14%	1,320	48%
CA	Hawthorne School District	27.5	7,615	277	9	3,884	51%	6,473	85%
CA	Fallbrook Union Elem Sch Dist	27.4	5,755	210	7	1,899	33%	2,187	38%
CA	Franklin-McKinley School Dist	27.3	9,940	364	13	6,461	65%	8,648	87%
CA	Di Giorgio Elem School Dist	27.3	191	7	1	136	71%	118	62%
CA	Santa Paula Un High Sch Dist	27.1	1,303	48	3	352	27%	938	72%
CA	Lucerne Elem School District	27.1	325	12	1	198	61%	52	16%
CA	McCabe Union Elem School Dist	27.0	540	20	1	119	22%	221	41%
CA	Fullerton Elem School District	27.0	11,200	415	16	3,472	31%	5,712	51%
CA	Gilroy Unified School District	26.9	8,548	318	13	3,183	37%	5,129	60%
CA	Vallejo City Unif Sch District	26.9	18,883	703	26	5,287	28%	13,029	69%
CA	Kings Canyon Unif School Dist	26.7	8,302	311	17	4,732	57%	5,728	69%
CA	Pleasanton Unif School Dist	26.6	10,100	380	13	303	3%	1,515	15%
CA	Antelope Valley Un H S Dist	26.6	13,335	502	8	1,734	13%	4,801	36%
CA	Cutten Elem School District	26.3	606	23	2	79	13%	61	10%

ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
CA	Rio Linda Union Elem Sch Dist	25.9	10,072	389	21	4,029	40%	2,921	29%
CA	Menifee Union School District	25.8	3,772	146	4	453	12%	717	19%
CA	Mendota Unified School Dist	25.8	2,192	85	5	1,995	91%	2,126	97%
CA	Corcoran Unif School District	25.7	3,184	124	6	1,910	60%	2,515	79%
CA	Western Placer Unif Sch Dist	25.5	2,757	108	6	882	32%	607	22%
CA	Buckeye Union School District	25.5	3,317	130	6	232	7%	66	2%
CA	El Rancho Unif School District	25.5	10,766	422	16	6,352	59%	10,120	94%
CA	Paradise Unif School District	25.4	5,350	211	8	1,338	25%	268	5%
CA	El Monte Unif Elem School Dist	24.9	11,210	450	18	8,520	76%	9,753	87%
CA	Laytonville Unif Sch District	24.9	647	26	5	0	0%	84	13%
CA	Coarsegold Union Sch District	24.5	980	40	2	225	23%	108	11%
CA	Downey Unified School District	24.4	17,701	725	22	6,195	35%	10,267	58%
CA	Empire Union School District	24.4	3,800	156	6	360	10%	1,558	41%
CA	Lassen View Union School Dist	24.3	340	14	1	177	52%	68	20%
CA	La Habra City School District	24.3	4,954	204	8	2,328	47%	2,873	58%
CA	Santa Ana Unif School District	24.2	46,556	1,920	44	26,537	57%	43,297	93%
CA	Weaver Union School District	24.2	1,450	60	3	1,131	78%	812	56%
CA	Stockton Unif School District	24.1	32,573	1,350	45	18,241	56%	25,733	79%
CA	Hollister School District	24.1	4,600	191	6	2,208	48%	2,806	61%
CA	Bellevue Union Elem Sch Dist	24.0	1,200	50	2	780	65%	552	46%
CA	Hueneme School District	24.0	7,601	317	11	4,029	53%	5,397	71%
CA	Dixon Unified School District	23.9	3,156	132	6	1,231	39%	1,357	43%
CA	Norwalk-La Mirada Un Sch Dist	23.8	18,898	795	29	7,181	38%	12,662	67%
CA	Chula Vista Elem School Dist	23.8	18,705	787	35	6,547	35%	11,971	64%
CA	Westminster Elem School Dist	23.8	9,075	382	18	4,447	49%	5,354	59%
CA	Monrovia Unif School District	23.7	5,718	241	10	2,859	50%	3,374	59%
CA	Fontana Unif School District	23.7	29,681	1,252	33	11,872	40%	18,105	61%
CA	Black Oak Mine Unif Sch Dist	23.7	2,225	94	6	490	22%	67	3%
CA	Ackerman Elem School District	23.7	355	15	1	82	23%	28	8%
CA	Atwater Elem School District	23.7	4,614	195	7	1,753	38%	2,030	44%
CA	Culver City Unif School Dist	23.7	5,300	224	10	1,219	23%	3,127	59%
CA	Ripon Unified School District	23.7	2,247	95	5	360	16%	472	21%
CA	Cucamonga School District	23.6	2,341	99	4	983	42%	1,545	66%
CA	Cajon Valley Union School Dist	23.6	17,871	756	27	6,791	38%	4,646	26%
CA	Fresno Unified School District	23.6	70,863	3,005	90	42,518	60%	47,478	67%
CA	Chico Unified School District	23.5	12,956	551	22	4,016	31%	2,332	18%
CA	El Centro Elem School District	23.5	6,418	273	10	3,979	62%	5,199	81%
CA	Colfax Elem School District	23.5	493	21	2	118	24%	74	15%
CA	Newhall Elementary School Dist	23.5	5,000	213	6	1,200	24%	1,350	27%
CA	Ocean View Elem School Dist	23.4	2,338	100	4	1,379	59%	1,660	71%
CA	Red Bluff Union High Sch Dist	23.4	1,753	75	2	351	20%	280	16%
CA	Santee School District	23.4	8,178	350	11	1,636	20%	900	11%
CA	Coronado Unif School District	23.4	2,452	105	4	319	13%	588	24%
CA	Chualar Union Elem Sch Dist	23.3	280	12	1	255	91%	269	96%

ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
CA	East Whittier City School Dist	23.3	7,864	338	13	2,202	28%	3,932	50%
CA	Pleasant Valley School Dist	23.2	6,952	300	14	556	8%	1,738	25%
CA	Plumas Unified School District	23.1	3,933	170	18	1,219	31%	433	11%
CA	Kernville Un School District	23.1	1,110	48	3	422	38%	100	9%
CA	Westside Union Elem Sch Dist	23.1	5,332	231	10	906	17%	1,173	22%
CA	Loomis Union Elem Sch District	23.1	1,800	78	3	234	13%	162	9%
CA	Panama-Buena Vista Un Sch Dist	23.0	11,296	491	17	2,372	21%	3,050	27%
CA	Palo Verde Unif Elem Sch Dist	23.0	460	20	1	345	75%	294	64%
CA	Burrel Union Elem School Dist	23.0	115	5	1	68	59%	106	92%
CA	Curtis Creek Elem Sch District	23.0	920	40	2	248	27%	46	5%
CA	Total		1,160,832	40,257	1,706	446,322		637,682	
CO	Brighton School District 27 J	45.3	4,304	95	9	990	23%	1,506	35%
CO	Falcon School District 49	32.0	3,269	102	6	392	12%	523	16%
CO	Woodland Park School Dist Re 2	29.9	2,898	97	5	348	12%	174	6%
CO	Mancos School District Re 6	28.8	576	20	3	167	29%	98	17%
CO	Douglas Co. School Dist R E 1	28.6	20,041	701	28	601	3%	1,002	5%
CO	Summit School District R E 1	25.0	2,126	85	6	85	4%	128	6%
CO	Gunnison-Watershed Dist Re 1 J	23.9	1,676	70	6	134	8%	67	4%
CO	Total		34,890	1,170	63	2,717		3,498	
CT	Chester School District	88.5	354	4	1	18	5%	7	2%
CT	Deep River School District	67.8	407	6	1	12	3%	12	3%
CT	Plymouth School District	63.0	1,891	30	5	151	8%	57	3%
CT	Hebron School District	62.2	933	15	2	19	2%	28	3%
CT	New Britain School District	40.1	8,832	220	14	3,268	37%	5,123	58%
CT	Guilford School District	39.7	3,414	86	7	68	2%	102	3%
CT	Waterbury School District	39.2	14,448	369	26	6,357	44%	7,802	54%
CT	Killingly School District	38.5	3,038	79	4	547	18%	122	4%
CT	Ledyard School District	34.3	3,064	90	6	62	2%	247	8%
CT	Glastonbury Public School Dist	33.9	5,180	153	8	207	4%	518	10%
CT	Bethany School District	31.7	47	15	1	5	1%	24	5%
CT	North Branford School District	30.5	2,264	75	5	69	3%	69	3%
CT	Kent School District	30.0	300	10	1	15	5%	12	4%
CT	Columbia School District	29.8	625	21	1	13	2%	19	3%
CT	West Haven School District	29.1	7,108	244	12	1,422	20%	1,990	28%
CT	Regional School District 10	28.3	2,267	80	4	45	2%	88	3%
CT	Canaan School District	27.0	135	5	1	16	12%	5	4%
CT	Cornwall School District	26.5	159	6	1	6	4%	6	4%
CT	Redding School District	25.2	881	35	2	9	1%	26	3%
CT	Easton School District	25.2	755	30	2	8	1%	23	3%
CT	Salisbury School District	25.0	375	15	1	34	9%	23	6%
CT	Wallingford School District	23.9	6,332	265	11	380	6%	380	6%
CT	Colchester School District	23.4	2,129	91	4	85	4%	85	4%
CT	Hartford School District	23.2	25,293	1,090	34	14,417	57%	23,017	91%
CT	Brookfield School District	23.1	2,500	108	4	25	1%	125	5%

SI	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
CT Total			93,199	3,142	158	27,256		39,888	
DE	Colonial School District	38.9	9,929	255	15	2,284	23%	3,376	34%
DE	Brandywine School District	24.2	11,380	470	18	1,935	17%	3,869	34%
DE Total			21,309	725	33	4,218		7,245	
GA	Columbia County School Dist	36.6	16,667	455	20	1,667	10%	2,833	17%
GA	Elbert County School District	34.4	3,919	114	6	1,489	38%	1,528	39%
GA	Pierce County School District	34.1	3,072	90	4	1,290	42%	522	17%
GA	Oglethorpe Co School District	33.1	1,820	55	3	619	34%	692	38%
GA	Fayette County School District	32.2	15,903	494	18	636	4%	954	6%
GA	Rome City School District	30.4	4,623	152	11	2,080	45%	1,803	39%
GA	Jeff Davis Co. School District	27.5	2,613	95	4	836	32%	523	20%
GA	Grady County School District	27.0	4,591	170	7	2,066	45%	1,836	40%
GA	Houston County School District	26.3	18,379	699	27	5,146	28%	5,146	28%
GA	Newton County School District	25.7	8,600	334	13	2,752	32%	2,752	32%
GA	Henry County School District	23.8	14,287	601	18	2,143	15%	2,429	17%
GA	Haralson County School Dist	23.1	3,045	132	8	853	28%	274	9%
GA Total			97,519	3,391	139	21,577		21,293	
IA	Winfield-Mount Union Comm S D	30.4	395	13	2	63	16%	4	1%
IA	Central City Comm School Dist	25.5	536	21	3	107	20%	5	1%
IA	Newton Community School Dist	23.3	3,424	147	9	445	13%	68	2%
IA Total			4,355	181	14	616		78	
ID	Mountain Home School Dist 193	30.1	4,210	140	10	842	20%	547	13%
ID	Emmett School District 221	29.6	2,780	94	9	862	31%	111	4%
ID	Lakeland School District 272	28.6	3,261	114	7	652	20%	65	2%
ID	Jefferson County Jt Dist 251	24.3	4,127	170	8	908	22%	206	5%
ID	Gooding Joint School Dist 231	24.2	1,209	50	3	314	26%	85	7%
ID	Buhl Joint School District 412	23.5	1,600	68	3	480	30%	96	6%
ID Total			17,187	636	40	4,058		1,111	
IL	Fremont School District 79	70.8	850	12	1	17	2%	68	8%
IL	Chaney-Monge School Dist 88	65.7	460	7	2	37	8%	27	6%
IL	Berwyn North School Dist 98	64.5	1,936	30	4	213	11%	368	19%
IL	Summersville School Dist 79	62.5	250	4	1	13	5%	0	0%
IL	Homer School District 33 C	56.4	3,100	55	4	62	2%	93	3%
IL	Hampton School District 29	53.5	214	4	1	9	4%	9	4%
IL	O'Fallon School District 90	53.3	2,400	45	4	168	7%	360	15%
IL	West Frankfort School Dist 168	47.4	1,990	42	4	378	19%	0	0%
IL	Lincoln Elem School Dist 156	46.0	690	15	1	104	15%	166	24%
IL	Cicero School District 99	40.7	9,766	240	13	1,270	13%	6,250	64%
IL	Malta Comm Unit Sch Dist 433	37.5	300	8	2	15	5%	9	3%
IL	Bensenville Elem School Dist 2	36.8	1,950	53	5	98	5%	878	45%
IL	Carbon Cliff-Barstow S D 36	36.4	255	7	2	8	3%	23	9%
IL	Union Ridge School District 86	35.8	537	15	1	27	5%	21	4%
IL	Quincy School District 172	35.7	6,968	195	10	836	12%	627	9%
IL	Iuka Comm Cons School Dist 7	35.3	353	10	1	99	28%	0	0%

ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
IL	Anna-Jonesboro Comm Hs Dist 8	34.7	520	15	1	88	17%	5	1%
IL	Troy School District 30-C	34.3	2,300	67	3	89	3%	253	11%
IL	Pleasant Valley School Dist 62	33.8	473	14	2	14	3%	109	23%
IL	East Peoria School District 86	33.5	2,011	60	7	121	6%	60	3%
IL	Marengo-Union Elem S D 165	33.5	1,005	30	2	40	4%	80	8%
IL	Manhattan School District 114	33.5	670	20	1	7	1%	0	0%
IL	McClellan C C School Dist 12	33.3	100	3	1	12	12%	2	2%
IL	Plano School District 88	32.8	1,310	40	4	66	5%	288	22%
IL	Smithton Cc School Dist 130	32.0	288	9	1	35	12%	3	1%
IL	Oak Lawn-Hometown Sch Dist 12	31.4	2,451	78	6	98	4%	74	3%
IL	Morris School District 54	31.4	1,505	48	4	75	5%	75	5%
IL	Community Cons School Dist 093	31.2	4,680	150	7	187	4%	749	16%
IL	Community High School Dist 094	30.9	1,700	55	1	51	3%	459	27%
IL	Centralia School District 135	30.9	1,700	55	7	204	12%	323	19%
IL	Dwight Common School Dist 232	30.4	700	23	1	49	7%	21	3%
IL	La Grange School District 102	30.4	2,400	79	5	72	3%	264	11%
IL	Prairie Grove School Dist 46	30.3	818	27	1	57	7%	8	1%
IL	Shiloh Village School Dist 85	30.1	451	15	1	23	5%	45	10%
IL	Elwood Comm Cons Sch Dist 203	30.0	300	10	1	3	1%	15	5%
IL	Meridian School District 101	30.0	1,200	40	2	588	49%	624	52%
IL	Bethalto School District 8	29.7	3,000	101	8	300	10%	30	1%
IL	Pinckneyville School Dist 50	29.3	645	22	2	58	9%	6	1%
IL	Benton Comm Cons Sch Dist 47	28.9	1,100	38	3	187	17%	0	0%
IL	Chicago Heights Sch Dist 170	28.9	3,328	115	11	765	23%	2,662	80%
IL	Mokena School District 159	28.7	1,750	61	3	53	3%	35	2%
IL	Dolton School District 148	28.6	2,490	87	8	125	5%	1,668	67%
IL	Mount Olive C U School Dist 5	28.6	600	21	2	60	10%	0	0%
IL	Galena School District 120	28.2	1,101	39	3	44	4%	11	1%
IL	Belleville Twp H S Dist 201	28.0	4,229	151	2	296	7%	592	14%
IL	East Prairie School Dist 73	27.7	415	15	1	25	6%	208	50%
IL	Westchester School Dist 92-5	27.4	905	33	3	27	3%	81	9%
IL	Woodland School District 50	27.0	4,111	152	4	123	3%	576	14%
IL	Aurora East School Dist 131	27.0	8,649	320	16	1,124	13%	5,881	68%
IL	Plainfield Comm Cons Dist 202	27.0	5,000	185	6	150	3%	200	4%
IL	Wabash Community Sch Dist 348	26.9	2,153	80	4	323	15%	22	1%
IL	Venice Comm Unit Sch Dist 3	26.9	457	17	2	123	27%	420	92%
IL	Collinsville Comm Sch Dist 10	26.6	5,790	218	13	521	9%	232	4%
IL	Du Quoin Comm Unit S D 300	26.4	1,555	59	4	156	10%	109	7%
IL	Mulberry Grove C U Sch Dist 1	26.2	550	21	3	94	17%	61	11%
IL	United Township H S Dist 30	26.0	2,000	77	1	180	9%	460	23%
IL	Charleston School District 1	25.8	3,202	124	8	352	11%	98	3%
IL	Carrier Mills-Stonefort Dist 2	25.5	637	25	2	83	13%	115	18%
IL	Rantoul Twp High Sch Dist 193	25.3	760	30	1	61	8%	137	18%
IL	Elmhurst C U School Dist 205	25.3	6,326	250	12	190	3%	569	9%

All Public School Districts and Districts in "Greatest Need" for Educational Technology
Alphabetical by State
Prepared by Quality Education Data, Denver, Colorado

| | All Public School Districts | | | | | | Districts with "Greatest Need" | | | | | | |
State	No. Districts	No. Schools	All Students	Poor Students	No. Computer	Students per Computer	No. Districts	No. Schools	All Students	Poor Students	No. Computers	Students per Computer	Students Pct. State
Alabama	127	1,378	748,487	175,144	46,544	16.0	21	191	99,655	24,403	3,432	29.0	13%
Alaska	53	453	120,083	20,089	14,364	8.4	1	1	209	127	7	29.9	0%
Arizona	214	1,078	719,745	116,908	71,227	10.1	13	40	31,850	5,464	1,043	30.3	4%
Arkansas	313	1,114	456,458	149,188	35,028	13.0	16	131	67,639	15,131	2,479	27.4	15%
California	992	7,901	5,220,002	1,996,848	327,903	15.9	175	1,708	1,160,632	446,974	40,257	28.8	22%
Colorado	176	1,351	647,695	119,268	57,920	11.2	7	63	34,890	2,717	1,170	29.8	5%
Connecticut	161	956	479,316	76,155	36,338	13.2	25	158	93,199	27,258	3,142	29.7	19%
D.C.	1	171	81,779	45,986	7,053	11.6							0%
Delaware	16	165	101,031	21,647	5,693	17.7	2	33	21,309	4,219	725	29.4	21%
Florida	67	2,568	2,135,317	640,447	229,866	9.3							0%
Georgia	181	1,855	1,271,054	391,844	119,395	10.6	12	139	97,519	21,577	3,391	28.8	5%
Hawaii	1	254	180,547	35,623	10,221	17.7							0%
Idaho	111	562	239,060	48,657	19,766	12.1	6	40	17,187	4,058	636	27.0	7%
Illinois	915	3,959	1,876,397	237,904	122,357	15.3	92	1,040	630,884	133,544	25,721	24.5	34%
Indiana	294	1,859	972,946	194,877	96,296	10.1	17	60	32,694	4,555	1,037	31.5	3%
Iowa	389	1,482	489,646	86,365	50,351	9.7	3	14	4,355	615	181	24.1	1%
Kansas	304	1,471	466,122	127,401	52,319	8.9	9	9	2,577	637	105	24.5	1%
Kentucky	176	1,323	645,954	130,549	65,979	9.8		38	18,245	4,733	661	27.6	3%
Louisiana	66	1,461	793,834	376,965	43,372	18.3	17	331	171,854	78,193	5,837	29.4	22%
Maine	221	700	215,953	32,453	16,769	12.9	24	68	27,058	4,347	996	27.2	13%
Maryland	24	1,293	784,524	158,895	59,402	13.2							0%
Massachusetts	303	1,763	853,820	101,169	58,006	14.7	63	345	171,323	20,393	5,859	29.2	20%
Michigan	556	3,374	1,633,431	375,386	136,676	12.0	42	224	104,489	24,755	3,443	30.3	6%
Minnesota	380	1,533	806,275	137,485	88,358	9.1	10	47	28,475	4,851	1,136	25.1	4%
Mississippi	149	971	515,388	274,078	32,722	15.8	22	143	83,520	37,869	2,646	31.6	16%
Missouri	531	2,075	866,814	157,288	70,111	12.4	60	186	82,205	14,545	2,519	32.6	9%
Montana	349	699	169,699	36,175	18,257	9.3	8	21	8,090	1,525	313	25.8	5%
Nebraska	649	1,301	291,075	56,582	30,669	9.5	70	81	4,441	1,201	151	29.4	2%
Nevada	17	401	250,938	40,522	21,595	11.6							0%

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State	No. Districts	No. Schools	All Public School Districts				Districts with "Greatest Need"						
			All Students	Poor Students	No. Computer	Students per Computer	No. Districts	No. Schools	All Students	Poor Students	No. Computers	Students per Computer	Students Pct. State
New Hampshire	162	433	185,290	22,053	13,050	14.2	36	109	43,332	4,579	966	44.9	23%
New Jersey	553	2,236	1,133,951	231,249	83,930	13.5	56	199	109,485	13,564	3,428	31.9	10%
New Mexico	89	681	313,278	80,615	29,954	10.5	7	7	4,300	4,300	174	24.7	1%
New York	697	3,996	2,690,858	470,608	233,453	11.5	10	101	5,587	489	227	24.6	0%
North Carolina	119	1,964	1,157,400	242,321	115,592	10.0	8	110	68,594	16,505	2,262	30.3	6%
North Dakota	234	438	118,093	21,616	15,917	7.4	1	1	102	34	4	25.5	0%
Ohio	611	3,672	1,824,410	391,373	127,309	14.3	84	432	228,616	35,402	8,197	27.9	13%
Oklahoma	553	1,777	619,120	169,791	50,775	12.2	43	124	45,700	11,441	1,506	30.3	7%
Oregon	248	1,202	522,709	104,513	41,700	12.5	14	101	53,842	12,496	2,145	25.1	10%
Pennsylvania	500	3,098	1,747,432	216,283	129,886	13.5	56	347	206,142	21,217	6,959	29.6	12%
Rhode Island	36	308	145,919	29,879	9,001	16.2	9	96	41,205	7,026	1,281	32.2	28%
South Carolina	91	1,107	660,370	237,373	67,702	9.8	9	114	64,825	26,966	2,364	27.4	10%
South Dakota	172	700	136,493	22,875	13,670	10.0	1	5	1,408	183	61	23.1	1%
Tennessee	138	1,565	877,538	162,390	54,603	16.1	41	461	266,815	41,536	8,946	29.8	30%
Texas	1,044	6,175	3,655,877	1,263,626	389,031	9.4	20	127	75,400	25,805	2,616	28.8	2%
Utah	40	707	479,299	81,632	47,545	10.1							0%
Vermont	246	349	98,783	14,683	6,941	13.9	46	75	23,606	3,645	618	38.2	24%
Virginia	133	1,825	1,068,783	141,527	95,389	11.2	18	150	73,594	14,239	2,393	30.8	7%
Washington	296	1,829	925,941	92,333	91,751	10.1	4	46	24,480	2,023	1,011	24.2	3%
West Virginia	55	886	320,285	106,877	31,891	10.0	4	50	18,377	5,796	392	46.9	6%
Wisconsin	427	1,969	848,622	155,042	81,969	10.4	10	28	13,506	2,003	508	26.7	2%
Wyoming	49	359	109,088	17,402	13,956	7.8							0%
Total	14,229	82,747	43,671,928	10,637,757	3,689,610	11.8	1,179	7,703	4,363,195	1,132,940	152,943	28.5	10%

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State	No. Districts	No. Students	Instructional Computers Now	Needed to Equal National Average	Cost to Reach National Average	Pct. of National Need	Ranking among States
California	175	1,160,632	40,257	57,769	$115,538,703	26.8%	51
Illinois	92	630,864	25,721	27,561	$55,122,865	12.8%	50
Tennessee	41	266,815	8,946	13,589	$27,178,101	6.3%	49
Ohio	84	228,616	8,197	11,112	$22,223,568	5.2%	48
Pennsylvania	56	206,142	6,959	10,452	$20,903,284	4.8%	47
Louisiana	17	171,854	5,837	8,678	$17,355,392	4.0%	46
Massachusetts	63	171,323	5,859	8,611	$17,221,696	4.0%	45
New Jersey	56	109,485	3,428	5,819	$11,638,088	2.7%	44
Michigan	42	104,489	3,443	5,382	$10,764,169	2.5%	43
Alabama	21	99,655	3,432	4,985	$9,969,615	2.3%	42
Georgia	12	97,519	3,391	4,845	$9,690,804	2.2%	41
Connecticut	25	93,199	3,142	4,730	$9,459,074	2.2%	40
Missouri	60	82,205	2,519	4,424	$8,847,960	2.1%	39
Mississippi	22	83,520	2,646	4,408	$8,816,108	2.0%	38
Virginia	18	73,594	2,393	3,823	$7,645,419	1.8%	37
Texas	20	75,400	2,616	3,752	$7,504,486	1.7%	36
North Carolina	8	68,594	2,282	3,531	$7,062,824	1.6%	35
Arkansas	16	67,839	2,479	3,251	$6,501,291	1.5%	34
South Carolina	9	64,825	2,364	3,111	$6,222,169	1.4%	33
New Hampshire	36	43,332	966	2,694	$5,387,595	1.2%	32
Oregon	14	53,842	2,145	2,402	$4,804,932	1.1%	31
Oklahoma	43	45,700	1,506	2,354	$4,707,595	1.1%	30
Rhode Island	9	41,205	1,281	2,199	$4,398,304	1.0%	29
Colorado	7	34,890	1,170	1,777	$3,553,581	0.8%	28
Indiana	17	32,694	1,037	1,724	$3,448,635	0.8%	27
Arizona	13	31,650	1,043	1,630	$3,260,284	0.8%	26
Vermont	46	23,606	618	1,376	$2,761,500	0.6%	25
Maine	24	27,058	996	1,280	$2,578,608	0.6%	24
Minnesota	10	28,475	1,136	1,269	$2,537,966	0.6%	23

Districts with "Greatest Need"

State	No. Districts	No. Students	Instructional Computers		Cost to Reach National Average	Pct. of National Need	Ranking among States
			Now	Needed to Equal National Average			
West Virginia	4	18,377	392	1,160	$2,320,223	0.5%	22
Delaware	2	21,309	725	1,075	$2,149,493	0.5%	21
Washington	4	24,480	1,011	1,057	$2,113,135	0.5%	20
Kentucky	7	18,245	661	880	$1,759,928	0.4%	19
Idaho	6	17,187	638	816	$1,631,209	0.4%	18
Wisconsin	10	13,506	506	635	$1,269,419	0.3%	17
Montana	8	8,090	313	370	$740,554	0.2%	16
New York	3	5,587	227	245	$489,750	0.1%	15
Nebraska	70	4,441	151	224	$448,189	0.1%	14
New Mexico	1	4,300	174	189	$376,351	0.1%	13
Iowa	3	4,355	181	187	$373,642	0.1%	12
Kansas	2	2,577	105	113	$225,304	0.1%	11
South Dakota	1	1,408	61	58	$115,838	0.0%	10
Alaska	1	209	7	11	$21,304	0.0%	9
North Dakota	1	102	4	5	$9,230	0.0%	8
D. C.	0	0	0	0	$0	0.0%	1
Florida	0	0	0	0	$0	0.0%	1
Hawaii	0	0	0	0	$0	0.0%	1
Maryland	0	0	0	0	$0	0.0%	1
Nevada	0	0	0	0	$0	0.0%	1
Utah	0	0	0	0	$0	0.0%	1
Wyoming	0	0	0	0	$0	0.0%	1
Total "Greatest Need"	1,179	4,363,195	152,943	215,570	$431,140,182	100.0%	
U.S. Total	14,229	43,671,928	3,689,510				
Needy Pct.	8.3%	10.0%	4.1%				

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Percent of Students in Districts with "Greatest Technology Need" by State
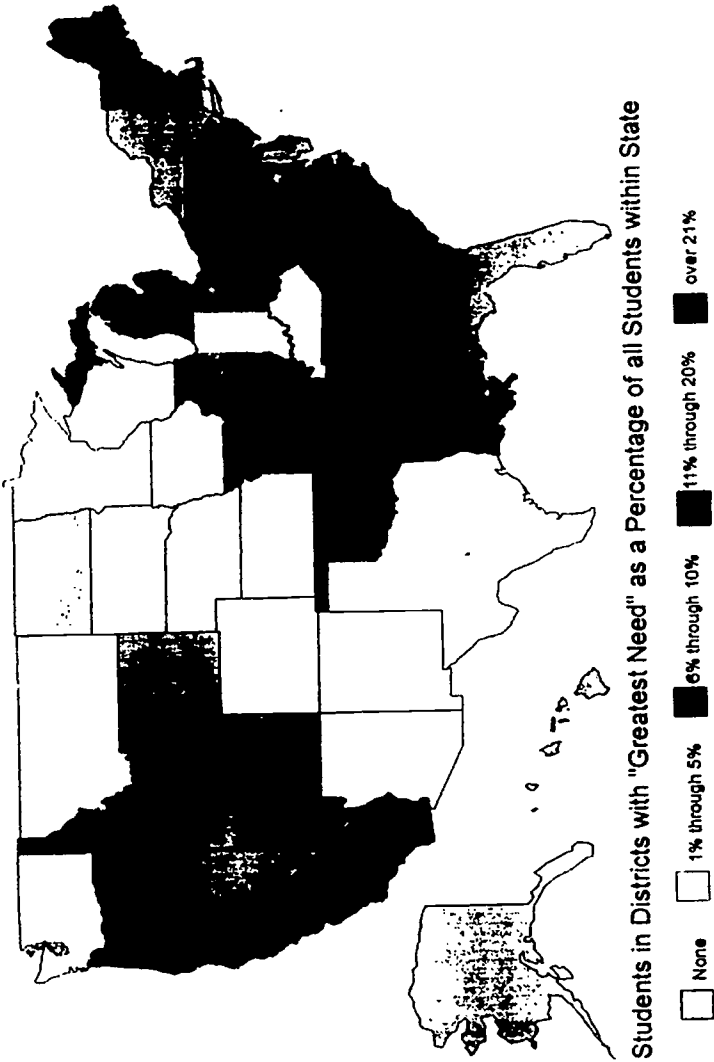
Students in Districts with "Greatest Need" as a Percentage of all Students within State

None   1% through 5%   6% through 10%   11% through 20%   over 21%

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Districts with "Greatest Need for Educational Technology"
By State
Prepared by Quality Education Data, Inc
March 28, 1995

ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
IN	Orleans Comm School District	26.9	753	28	2	211	28%	0	0%
IN	Taylor Community School Corp.	24.6	1,748	71	3	262	15%	70	4%
IN	West Noble School Corporation	23.5	2,350	100	4	447	19%	141	6%
IN	Daleville Comm School District	23.4	655	28	2	72	11%	0	0%
IN	Plainfield Comm School Corp.	23.2	3,458	149	6	242	7%	0	0%
IN	Lebanon Community School Corp	23.0	3,041	132	6	335	11%	30	1%
IN Total			32,694	1,037	60	4,555		566	
KS	Lebo-Waverly School Dist 243	24.6	616	25	4	166	27%	6	1%
KS	Paola Unified School Dist 368	24.5	1,961	80	5	471	24%	118	6%
KS Total			2,577	105	9	637		124	
KY	Boyd County School District	30.7	3,900	127	7	468	12%	0	0%
KY	Harlan Indep School District	30.6	917	30	2	385	42%	73	8%
KY	Middlesboro Indep School Dist	29.1	1,831	63	4	586	32%	128	7%
KY	Woodford County School Dist	28.4	3,830	135	7	498	13%	268	7%
KY	Owen County School District	27.3	1,800	66	4	504	28%	36	2%
KY	Whitley County School District	25.1	4,398	175	10	1,539	35%	0	0%
KY	Clinton County School District	24.1	1,569	65	4	753	48%	0	0%
KY Total			18,245	661	38	4,733		505	
LA	Terrebonne Parish Sch District	68.3	20,500	300	43	9,020	44%	6,785	33%
LA	West Carroll Parish Sch Dist	33.7	2,695	80	8	1,240	46%	485	18%
LA	Evangeline Parish School Dist	32.9	7,150	217	16	4,719	66%	2,646	37%
LA	Livingston Parish School Dist	32.1	18,000	560	32	5,040	28%	1,260	7%
LA	Bienville Parish School Dist	30.3	3,211	106	9	1,413	44%	1,766	55%
LA	East Carroll Parish Sch Dist	29.9	2,212	74	6	1,991	90%	1,991	90%
LA	Jefferson Davis Parish Dist	28.1	6,803	242	14	2,925	43%	1,769	26%
LA	East Feliciana Parish Sch Dist	27.7	3,212	116	7	1,670	52%	2,184	68%
LA	Assumption Parish School Dist	27.4	4,900	179	11	2,842	58%	2,156	44%
LA	East Baton Rouge Parish Dist	27.1	59,672	2,200	105	27,449	46%	35,206	59%
LA	Winn Parish School District	26.3	3,292	125	9	1,646	50%	1,185	36%
LA	Caldwell Parish School Dist	25.9	2,074	80	6	1,058	51%	519	25%
LA	Avoyelles Parish School Dist	25.8	7,258	281	12	4,645	64%	2,758	38%
LA	St Helena Parish School Dist	25.7	1,797	70	3	1,402	78%	1,436	80%
LA	Bogalusa City School District	25.6	3,706	145	9	2,149	58%	1,631	44%
LA	Bossier Parish School Dist	23.9	18,036	754	30	4,510	25%	5,231	29%
LA	St John Parish School District	23.8	7,334	308	11	4,474	61%	4,327	59%
LA Total			171,854	5,837	331	78,192		73,316	
MA	Newburyport School District	64.7	2,264	35	5	226	10%	45	2%
MA	Clarksburg School District	62.5	250	4	1	10	4%	5	2%
MA	Wachusett Regional School Dist	58.6	5,803	99	12	290	5%	174	3%
MA	Buckland-Colrain-Shelburn Dist	57.6	461	8	2	32	7%	9	2%
MA	Brookfield School District	54.1	379	7	1	110	29%	4	1%
MA	Sturbridge School District	47.2	897	19	1	72	8%	9	1%
MA	Tantasqua Reg High School Dist	46.8	1,404	30	3	183	13%	14	1%
MA	Mohawk Trail Reg H S District	43.3	780	18	1	94	12%	8	1%

Districts with "Greatest Need for Educational Technology"
By State
Prepared by Quality Education Data, Inc.

ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
MA	Halifax School District	42.1	632	15	1	63	10%	13	2%
MA	Plainville School District	42.1	674	16	2	54	8%	20	3%
MA	Bridgewater Public School Dist	41.5	2,530	61	5	127	5%	76	3%
MA	Norfolk School District	40.9	981	24	2	49	5%	29	3%
MA	Rochester School District	40.1	802	20	1	104	13%	8	1%
MA	Fall River Public School Dist	39.3	12,268	313	33	2,580	21%	860	7%
MA	Pelham School District	38.3	115	3	1	7	6%	9	8%
MA	Milton Public School District	36.0	3,538	93	6	212	6%	425	12%
MA	Amherst Pelham Region Sch Dist	35.4	1,842	52	2	221	12%	461	25%
MA	Hanover School District	35.4	2,230	63	5	112	5%	45	2%
MA	South Hadley School District	34.9	2,305	66	4	161	7%	92	4%
MA	Central Berkshire Reg Sch Dist	34.3	2,469	72	6	222	9%	25	1%
MA	Pembroke School District	34.2	1,505	44	3	90	6%	0	0%
MA	Triton Regional Sch District	33.4	3,444	103	7	310	9%	34	1%
MA	Pentucket Reg. School District	32.8	3,014	92	6	211	7%	30	1%
MA	Falmouth School District	32.6	4,992	153	7	599	12%	399	8%
MA	Conway School District	31.7	190	6	1	25	13%	8	4%
MA	Freetown School District	31.6	631	20	1	32	5%	6	1%
MA	Northborough School District	31.5	1,735	55	4	69	4%	139	8%
MA	Hampshire Reg. School District	31.2	655	21	1	52	8%	7	1%
MA	Hawlemont School District	30.8	154	5	1	29	19%	3	2%
MA	Duxbury Public School District	30.1	2,709	90	3	54	2%	54	2%
MA	Athol-Royalston Reg. Sch Dist	29.9	2,305	77	9	254	11%	92	4%
MA	North Attleboro School Dist	29.7	4,160	140	9	291	7%	166	4%
MA	Dartmouth School District	29.4	3,971	135	6	238	6%	119	3%
MA	Amherst School District	28.5	1,484	52	4	193	13%	475	32%
MA	Southwick-Tolland Reg Sch Dist	28.3	1,700	60	3	51	3%	51	3%
MA	Plympton School District	27.9	279	10	1	28	10%	0	0%
MA	Quincy Public School District	27.3	8,201	300	17	964	12%	1,394	17%
MA	Dennis-Yarmouth Reg. Sch Dist	27.3	4,497	165	7	585	13%	315	7%
MA	Leominster School District	27.0	5,220	193	7	574	11%	992	19%
MA	Springfield School District	26.5	23,823	900	43	6,670	28%	14,770	62%
MA	Pioneer Valley Reg School Dist	26.0	1,196	46	5	106	9%	24	2%
MA	Newton School District	25.5	10,199	400	20	408	4%	1,632	16%
MA	Salem Public School District	25.3	4,398	174	8	615	14%	1,011	23%
MA	Shutesbury School District	25.1	251	10	1	13	5%	13	5%
MA	Amesbury School District	25.1	2,709	108	5	325	12%	54	2%
MA	North Middlesex Reg. Sch Dist	25.1	4,635	185	7	232	5%	46	1%
MA	Oak Bluffs School District	24.7	371	15	1	56	15%	45	12%
MA	Ayer School District	24.7	1,383	56	3	152	11%	429	31%
MA	Westford School District	23.9	3,221	135	6	129	4%	64	2%
MA	Franklin School District	23.8	3,956	166	7	237	6%	119	3%
MA	Rockport School District	23.8	952	40	2	114	12%	0	0%
MA	Marion School District	23.8	713	30	1	71	10%	64	9%

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Districts with "Greatest Need for Educational Technology"
By State
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ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
MA	Adams-Cheshire School District	23.7	1,994	84	4	160	8%	0	0%
MA	Sherborn School District	23.7	450	19	1	23	5%	23	5%
MA	Randolph School District	23.6	3,900	165	8	312	8%	1,131	29%
MA	Mendon-Upton Reg. Sch District	23.5	1,294	55	4	91	7%	26	2%
MA	Brimfield School District	23.5	352	15	1	49	14%	4	1%
MA	North Adams Public School Dist	23.4	2,106	90	5	358	17%	105	5%
MA	Gardner School District	23.4	2,782	119	6	334	12%	167	6%
MA	Reading School District	23.3	3,686	158	7	147	4%	147	4%
MA	Wales School District	23.2	209	9	1	13	6%	6	3%
MA	Old Rochester Reg. School Dist	23.2	950	41	2	86	9%	67	7%
MA	Auburn School District	23.1	2,305	100	6	92	4%	69	3%
MA	Total		171,323	5,859	345	20,393		26,630	
ME	Monhegan Plt School District		5	0	1	0	0%	0	0%
ME	Vassalboro School District	91.4	457	5	1	78	17%	0	0%
ME	Princeton School Department	72.3	217	3	1	33	15%	0	0%
ME	East Millinocket Sch District	59.7	597	10	2	101	17%	0	0%
ME	Sabattus School Department	55.7	557	10	1	150	27%	0	0%
ME	Bath School District	44.2	2,212	50	6	354	16%	66	3%
ME	Medway School District	43.0	344	8	2	24	7%	0	0%
ME	Machias School District	34.4	619	18	2	149	24%	0	0%
ME	Fayette School District	34.0	170	5	1	0	0%	168	99%
ME	Hancock School District	30.8	246	8	1	42	17%	0	0%
ME	Poland School District	29.9	597	20	1	48	8%	0	0%
ME	Jonesboro School District	27.7	83	3	1	36	43%	0	0%
ME	Litchfield School Department	27.5	550	20	2	72	13%	0	0%
ME	Calais School District 106	26.3	1,576	60	3	299	19%	0	0%
ME	School Admin District 17	26.2	3,933	150	11	669	17%	39	1%
ME	Winslow School District	24.8	1,441	58	3	115	8%	0	0%
ME	School Admin District 57	24.3	3,279	135	8	361	11%	33	1%
ME	China School District	24.2	606	25	1	103	17%	0	0%
ME	School Admin District 75	24.0	3,357	140	7	336	10%	34	1%
ME	Manchester School District	23.8	238	10	1	0	0%	236	99%
ME	Readfield School District	23.3	233	10	1	0	0%	231	99%
ME	School Admin District 35	23.2	2,484	107	4	298	12%	25	1%
ME	Westbrook School Department	23.1	2,797	121	6	336	12%	28	1%
ME	Oak Hill Cons School Dist 915	23.0	460	20	1	97	21%	0	0%
ME	Total		27,058	996	68	3,699		859	
MI	Oneida Twp School District 3		17	0	1	4	24%	0	0%
MI	Taylor School District	50.3	12,274	244	23	3,191	26%	1,227	10%
MI	Beecher Comm School District	48.6	3,450	71	9	3,278	95%	2,588	75%
MI	Lapeer Community School Dist	46.4	7,749	167	16	1,317	17%	232	3%
MI	Inkster Public School District	41.1	2,796	68	5	1,510	54%	2,712	97%
MI	Maple Valley School District	32.f	1,640	50	4	312	19%	16	1%
MI	Dryden Community School Dist	32.7	720	22	2	65	9%	7	1%

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ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
MI	West Branch-Rose City Sch Dist	32.5	2,923	90	4	1,111	38%	58	2%
MI	Three Rivers School District	32.0	3,200	100	8	832	26%	448	14%
MI	Berkley School District	31.8	4,415	139	8	397	9%	177	4%
MI	Brandon School District	31.5	3,021	96	6	181	6%	30	1%
MI	Saline Area School District	30.6	3,950	129	5	119	3%	119	3%
MI	Atlanta Comm School District	30.0	570	19	2	353	62%	6	1%
MI	Clawson City School District	29.5	1,770	60	4	89	5%	35	2%
MI	Westwood Comm School District	28.8	2,392	83	4	981	41%	1,316	55%
MI	Belding Area School District	28.6	2,170	76	5	651	30%	22	1%
MI	Mid-Peninsula School District	28.4	426	15	1	213	50%	0	0%
MI	Potterville School District	27.7	1,051	38	2	242	23%	32	3%
MI	Manistee Area Public Schools	27.6	2,043	74	7	490	24%	163	8%
MI	Elk Rapids School District	27.2	1,359	50	4	231	17%	54	4%
MI	Munising Public Sch District	27.0	1,133	42	3	136	12%	215	19%
MI	Hamtramck Public School Dist	26.7	2,672	100	5	1,630	61%	615	23%
MI	Tri County Area School Dist	26.5	2,038	77	4	306	15%	20	1%
MI	Forest Park School District	26.3	788	30	2	63	8%	24	3%
MI	Napoleon Comm School District	26.2	1,493	57	4	209	14%	15	1%
MI	Reeths-Puffer School District	25.9	4,637	179	9	417	9%	325	7%
MI	Crawford Ausable School Dist	25.8	2,196	85	4	878	40%	22	1%
MI	Ferndale Public School Dist	25.6	4,610	180	11	1,383	30%	876	19%
MI	Ypsilanti School District	25.6	4,653	182	12	838	18%	1,954	42%
MI	Howell Public School District	25.4	5,921	233	8	296	5%	178	3%
MI	Littlefield School District	25.1	501	20	1	50	10%	10	2%
MI	Marlee School District	25.0	225	9	1	32	14%	11	5%
MI	Union City Comm School Dist	25.0	1,323	53	4	397	30%	13	1%
MI	Bath Community School District	24.6	1,008	41	3	181	18%	20	2%
MI	Oxford Community Schools	24.2	3,000	124	6	240	8%	0	0%
MI	Grant Public School District	23.9	2,149	90	4	645	30%	322	15%
MI	Ravenna Public School District	23.7	1,257	53	4	327	26%	25	2%
MI	Colon Comm School District	23.6	1,062	45	3	170	16%	11	1%
MI	Flat Rock Comm School District	23.6	1,533	65	4	445	29%	46	3%
MI	Dewitt Public School District	23.6	2,003	85	5	120	6%	60	3%
MI	Michigan Center Pub Sch Dist	23.1	1,200	52	4	264	22%	24	2%
MI	Byron Area School District	23.0	1,151	50	3	161	14%	12	1%
MI	Total		104,489	3,443	224	24,753		14,040	
MN	St James School District 840	31.7	1,333	42	3	120	9%	107	8%
MN	St Michael-Albertville S D 885	31.5	1,891	60	4	132	7%	19	1%
MN	Red Lake School District 38	25.3	1,264	50	4	657	52%	1,251	99%
MN	Annandale School District 876	25.2	1,841	73	3	295	16%	37	2%
MN	St Cloud School District 742	24.6	14,161	576	18	2,266	16%	708	5%
MN	Perham School District 549	24.6	1,475	60	3	428	29%	30	2%
MN	Milaca School District 912	23.8	1,663	70	3	333	20%	50	3%
MN	Sauk Rapids School District 47	23.7	3,087	130	5	370	12%	0	0%

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MN	Big Lake School District 727	23.5	1,410	60	3	183	13%	14	1%
MN	Ashby School District 261	23.3	350	15	1	67	19%	4	1%
MN	Total		28,475	1,136	47	4,851		2,219	
MO	South Iron School District R 1	405.0	405	1	2	89	22%	4	1%
MO	South Holt School District R 1	73.8	443	6	2	226	51%	4	1%
MO	Kingsville School District R 1	66.3	265	4	2	42	16%	11	4%
MO	Chadwick School District R 1	60.5	242	4	2	41	17%	7	3%
MO	Clinton Co R 3 School District	57.1	800	14	3	112	14%	72	9%
MO	Nixa School District R 2	55.4	2,769	50	5	332	12%	0	0%
MO	Warsaw School District R 9	50.2	1,155	23	4	277	24%	0	0%
MO	Eldon School District R 1	48.8	2,441	50	4	342	14%	0	0%
MO	Fox School District C 6	48.1	9,613	200	12	577	6%	288	3%
MO	Elsberry School District R 2	44.0	880	20	2	185	21%	26	3%
MO	Bismarck R 5 School District	40.2	683	17	2	266	39%	7	1%
MO	Troy School District R 3	39.5	3,400	86	6	374	11%	136	4%
MO	Camdenton School Dist R 3	38.1	3,539	93	7	708	20%	35	1%
MO	Mark Twain School District R 8	38.0	76	2	1	6	8%	0	0%
MO	Dallas County School Dist 1	37.4	2,242	60	5	448	20%	0	0%
MO	De Soto School District 73	36.7	3,305	90	4	892	27%	33	1%
MO	Cole County School Dist R 5	35.8	860	24	2	120	14%	0	0%
MO	Maryville R 2 School District	34.9	1,743	50	4	192	11%	17	1%
MO	Gainesville School District R5	34.5	725	21	2	266	37%	7	1%
MO	North Pemiscot School Dist R 1	34.3	515	15	2	407	79%	106	21%
MO	Clayton School District	34.3	2,401	70	6	360	15%	720	30%
MO	Saint Clair School Dist R 13	33.6	2,350	70	4	376	16%	47	2%
MO	Festus School District R 6	33.6	2,484	74	3	174	7%	124	5%
MO	Roscoe School District C 1	33.5	201	6	1	82	41%	0	0%
MO	Sparta School District R 3	33.1	661	20	2	73	11%	0	0%
MO	Cass Co. School District R 5	31.4	503	16	2	106	21%	10	2%
MO	Lamar School District R 1	29.7	1,487	50	4	266	18%	0	0%
MO	Scott County School Dist R 2	29.6	680	23	2	218	32%	0	0%
MO	Cameron School District R 1	29.4	1,471	50	4	132	9%	15	1%
MO	Clever School District R 5	29.4	500	17	2	75	15%	0	0%
MO	Gilman City Schools	29.0	174	6	2	68	39%	0	0%
MO	Carrollton School District R 7	28.5	1,309	46	4	262	20%	39	3%
MO	Northwest School District R 1	28.1	7,425	264	10	1,114	15%	74	1%
MO	Purdy School District R 2	27.9	530	19	2	207	39%	11	2%
MO	Kirbyville School District R 6	27.8	222	8	1	51	23%	0	0%
MO	East Newton School District R6	27.4	1,372	50	3	398	29%	14	1%
MO	Maries Co. School District R 2	27.3	820	30	3	139	17%	0	0%
MO	Doniphan School District 1	27.2	1,880	69	4	583	31%	0	0%
MO	Pleasant Hill School Dist R 3	26.9	1,481	55	3	163	11%	0	0%
MO	Ava School District R 1	26.7	1,600	60	3	400	25%	0	0%
MO	Skyline School District R 2	26.7	160	6	1	50	31%	0	0%

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MO	Crane School District R 3	26 6	665	25	2	200	30%	7	1%
MO	South Pemiscot School Dist R 5	26.5	796	30	3	326	41%	175	22%
MO	Camden Co. School District R 2	25.5	535	21	2	64	12%	0	0%
MO	Phelps County School Dist R 3	25.3	228	9	1	32	14%	0	0%
MO	Dunklin School District R 5	25.2	1,613	64	4	97	6%	32	2%
MO	Mirabile School District C 1	25.0	50	2	1	5	9%	0	0%
MO	Moniteau Co. School Dist R 1	24.9	1,270	51	2	279	22%	38	3%
MO	Pierce City School District R6	24.8	620	25	2	155	25%	0	0%
MO	Neil Holcomb School Dist R 4	24.2	290	12	1	0	0%	6	2%
MO	Jenkins School District 35	24.0	72	3	1	35	48%	0	0%
MO	Fredericktown School Dist R 1	23.8	1,855	78	4	390	21%	0	0%
MO	Greenfield School District R 4	23.6	542	23	2	211	39%	0	0%
MO	Crawford County Sch Dist R 1	23.5	939	40	3	94	10%	0	0%
MO	North Callaway School Dist R 1	23.5	1,009	43	4	111	11%	20	2%
MO	Pettis Co School District R 05	23.4	422	18	2	131	31%	0	0%
MO	Gentry County School Dist R 2	23.3	420	18	2	118	28%	0	0%
MO	Belton School District 124	23.3	4,188	180	7	586	14%	251	6%
MO	Newburg School District R 2	23.2	579	25	2	110	19%	17	3%
MO	Hurley School District R 1	23.1	300	13	2	108	36%	0	0%
MO	Total		82,205	2,519	186	14,254		2,358	
MS	Starkville School District	51.9	4,099	79	9	2,050	50%	2,418	59%
MS	Quitman School District	51.3	3,077	60	5	1,815	59%	1,631	53%
MS	Pontotoc Co. School District	45.3	2,715	60	3	815	30%	326	12%
MS	Canton Public School District	41.6	3,662	88	5	3,406	93%	3,518	96%
MS	Clinton Public School District	40.6	5,315	131	8	1,222	23%	1,701	32%
MS	Moss Point School District	38.9	5,838	150	9	2,919	50%	3,561	61%
MS	West Point School District	37.7	3,849	102	8	2,348	61%	2,733	71%
MS	Lauderdale Co. School District	32.9	6,838	208	8	2,325	34%	2,051	30%
MS	South Tippah School District	30.1	3,247	108	8	1,266	39%	812	25%
MS	Madison County School District	29.8	6,712	225	10	2,886	43%	3,759	56%
MS	Lamar County School District	29.8	5,299	178	8	1,431	27%	424	8%
MS	Water Valley School District	20.5	1,415	48	2	750	53%	651	46%
MS	Walthall County School Dist	29.2	3,097	106	5	2,199	71%	1,827	59%
MS	Choctaw County School District	28.2	2,055	73	5	1,151	56%	904	44%
MS	Amory School District	27.8	2,387	86	5	979	41%	907	38%
MS	Lowndes County School District	27.1	5,412	200	10	2,111	39%	2,652	49%
MS	Tate County School District	27.0	3,050	113	6	1,678	55%	1,556	51%
MS	Marshall County School Dist	25 7	3,388	132	6	2,575	76%	2,101	62%
MS	Picayune School District	25.2	4,165	165	9	1,874	45%	1,166	28%
MS	Clay County School District	25.0	550	22	2	462	84%	490	89%
MS	Tishomingo Co School District	23 9	3,150	132	7	347	11%	126	4%
MS	Pearl Public School District	23 3	4,200	180	5	1,260	30%	882	21%
MS	Total		83,520	2,646	143	37,867		36,192	
MT	Paradise School District 8	67	0	1		36	53%	4	6%

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MT	Auchard Creek Elem Sch Dist 27	31.0	31	1	1	10	33%	5	15%
MT	Valley View School District 35	27.0	27	1	1	0	0%	5	17%
MT	Kalispell School District 5	26.6	4,660	174	9	746	16%	233	5%
MT	Bynum School District 12	26.5	53	2	1	7	14%	3	6%
MT	Somers School District 29	26.3	500	19	1	130	26%	5	1%
MT	Havre School District 16 A	23.7	2,659	112	6	558	21%	425	16%
MT	Ophir School District 72	23.3	93	4	1	11	12%	16	17%
MT Total			8,090	313	21	1,498		696	
NC	Edenton-Chowan County Sch Dist	49.1	2,600	53	4	936	36%	1,300	50%
NC	Yadkin County School District	41.4	5,050	122	10	657	13%	404	8%
NC	Bertie County School District	37.1	4,669	126	9	2,521	54%	3,548	76%
NC	Pender County School District	33.1	5,392	163	10	1,564	29%	2,265	42%
NC	Wilkes County School District	31.7	10,065	318	22	1,912	19%	604	6%
NC	Onslow County School District	29.3	23,778	812	29	4,993	21%	7,371	31%
NC	Cleveland County School Dist	27.6	8,500	308	11	1,275	15%	1,955	23%
NC	Beaufort County School Dist	23.7	8,540	360	15	2,647	31%	3,501	41%
NC Total			68,594	2,262	110	16,505		20,949	
ND	Bowdon School District 23	25.5	102	4	1	34	33%	0	0%
ND Total			102	4	1	34		0	
NE	Wheeler Central School Dist	35.0	210	6	2	61	29%	0	0%
NE	Columbus Public School Dist	24.2	3,515	145	11	457	13%	70	2%
NE Total			3,725	151	13	518		70	
NH	Litchfield School District	258.0	774	3	2	31	4%	15	2%
NH	Strafford School District	163.3	490	3	1	29	6%	5	1%
NH	Wakefield School District	152.7	458	3	2	82	18%	0	0%
NH	Stratham School District	118.2	709	6	1	7	1%	7	1%
NH	Henniker School District	112.2	561	5	2	28	5%	11	2%
NH	Wentworth School District	87.0	87	1	1	27	31%	2	2%
NH	Winnisquam Reg School District	81.0	1,781	22	4	125	7%	0	0%
NH	Winchester School District	74.9	824	11	2	190	23%	8	1%
NH	Thornton School District	71.7	215	3	1	37	17%	0	0%
NH	Concord School District	71.5	5,363	75	11	644	12%	161	3%
NH	Weare School District	70.0	980	14	2	98	10%	0	0%
NH	Windham School District	67.2	1,680	25	3	34	2%	34	2%
NH	Newport School District	65.1	1,236	19	3	260	21%	0	0%
NH	Hillsborough-Deering Sch Dist	65.0	1,300	20	3	143	11%	39	3%
NH	Milton School District	60.4	604	10	2	72	12%	6	1%
NH	Auburn Village School District	58.8	588	10	1	29	5%	12	2%
NH	Seabrook School District	57.2	686	12	1	192	28%	34	5%
NH	Pembroke School District	54.1	2,057	38	4	185	9%	41	2%
NH	Somersworth School District	47.6	1,808	38	4	253	14%	90	5%
NH	Mascenic Reg School District	45.9	1,377	30	6	165	12%	0	0%
NH	Sunapee School District	45.3	543	12	2	43	8%	0	0%
NH	Monadnock Reg School District	42.0	2,605	62	8	287	11%	0	0%

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NH	Raymond School District	36.5	1,789	49	3	215	12%	0	0%
NH	Wentworth Reg. School District	34.7	2,535	73	8	532	21%	0	0%
NH	Pelham School District	32.6	1,630	50	3	98	6%	49	3%
NH	Exeter School District	32.1	3,526	110	5	176	5%	71	2%
NH	Mascoma Valley Reg School Dist	32.0	1,600	50	4	176	11%	0	0%
NH	Wilton School District	30 0	300	10	1	33	11%	3	1%
NH	Winnacunnet Coop School Dist	29.5	943	32	1	66	7%	9	1%
NH	Waterville Valley School Dist	29.0	29	1	1	7	23%	0	0%
NH	Dresden School District	26.6	930	35	2	9	1%	28	3%
NH	Stoddard School District	26.0	52	2	1	3	5%	0	0%
NH	Lincoln-Woodstock Coop Schs	26.0	390	15	1	55	14%	0	0%
NH	Contoocook Valley Reg Sch Dist	24.7	2,029	82	11	142	7%	20	1%
NH	New Boston School District	24.7	370	15	1	19	5%	0	0%
NH	Northwood School District	24.2	483	20	1	87	18%	10	2%
NH	Total		43,332	966	109	4,578		656	
NJ	Chathams School District	95.4	2,290	24	5	92	4%	115	5%
NJ	Old Bridge Twp School District	60.6	8,970	148	15	628	7%	1,794	20%
NJ	Matawan-Aberdeen Reg. Sch Dist	47.1	3,860	82	6	386	10%	926	24%
NJ	Hamilton Township School Dist	46.0	1,793	39	3	359	20%	502	28%
NJ	Washington Twp School District	41.9	713	17	2	36	5%	7	1%
NJ	Vernon Township School Dist	41.5	4,900	118	6	196	4%	147	3%
NJ	Colts Neck Twp School District	38.6	850	22	2	17	2%	68	8%
NJ	Kearny School District	37.0	5,000	135	7	450	9%	1,250	25%
NJ	North Bergen School District	36.7	6,353	173	7	2,096	33%	4,193	66%
NJ	Black Horse Pike Reg. Sch Dist	36.2	2,860	79	2	114	4%	343	12%
NJ	Garfield School District	36.2	3,185	88	7	956	30%	796	25%
NJ	Sayreville School District	35.7	4,778	134	6	334	7%	717	15%
NJ	Burlington Township Sch Dist	34.3	1,644	48	4	230	14%	592	36%
NJ	Summit School District	34.1	2,388	70	7	143	6%	454	19%
NJ	Washington Twp School District	33.4	534	16	1	16	3%	32	6%
NJ	Clayton School District	32.9	1,150	35	3	230	20%	276	24%
NJ	Florence Township School Dist	32.5	1,461	45	4	219	15%	205	14%
NJ	Dover School District	31.0	2,386	77	4	764	32%	1,599	67%
NJ	Tinton Falls School District	30.5	1,679	55	3	235	14%	554	33%
NJ	Franklin Township School Dist	30.3	303	10	1	6	2%	0	0%
NJ	Bellmawr Borough School Dist	30.0	960	32	3	230	24%	67	7%
NJ	Wharton Borough School Dist	29.5	590	20	2	71	12%	177	30%
NJ	Central Regional School Dist	29 2	1,898	65	2	209	11%	152	8%
NJ	Westfield School District	29.0	4,635	160	9	93	2%	603	13%
NJ	Haledon School District	28 4	710	25	1	128	18%	163	23%
NJ	Highland Park Public Sch Dist	27 8	1,500	54	3	210	14%	540	36%
NJ	Lindenwold Boro School Dist	27 7	1,385	50	3	319	23%	416	30%
NJ	Tabernacle Twp School District	27 3	1,175	43	3	59	5%	35	3%
NJ	Lenape Reg High Sch District	27 1	5,153	190	3	52	1%	361	7%

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NJ	Swedesboro-Woolwich Sch Dist	26.7	481	18	1	135	28%	120	25%
NJ	Elk Township School District	26.7	400	15	1	88	22%	100	25%
NJ	Clinton Town School District	26.7	480	18	1	24	5%	34	7%
NJ	Dunellen School District	26.5	875	33	3	70	8%	131	15%
NJ	Lakewood Twp School District	26.4	4,247	161	6	1,486	35%	2,378	56%
NJ	Middle Township School Dist	26.2	2,621	100	4	524	20%	577	22%
NJ	Keyport School District	26.2	1,100	42	2	264	24%	242	22%
NJ	Flemington-Raritan Region Dist	26.0	2,600	100	4	78	3%	156	6%
NJ	Audubon School District	25.8	1,550	60	3	155	10%	16	1%
NJ	Closter School District	25.8	850	33	3	9	1%	272	32%
NJ	Maple Shade Township Sch Dist	25.5	2,016	79	4	222	11%	202	10%
NJ	Delaware Twp School District	25.5	510	20	1	10	2%	15	3%
NJ	Southampton Twp School Dist	25.1	880	35	2	79	9%	18	2%
NJ	Somerdale School Dist	25.0	450	18	1	86	19%	113	25%
NJ	Roxbury Twp School District	24.3	4,130	170	7	124	3%	372	9%
NJ	Oradell Public School District	24.0	600	25	1	6	1%	78	13%
NJ	Cresskill School District	23.9	1,076	45	3	11	1%	323	30%
NJ	Pitman Public School District	23.9	1,782	75	5	143	8%	36	2%
NJ	Gloucester City School Dist	23.9	1,862	78	7	521	28%	37	2%
NJ	Alexandria Twp School District	23.8	476	20	2	14	3%	19	4%
NJ	New Milford Public School Dist	23.8	1,663	70	4	50	3%	299	18%
NJ	Lincoln Park Public Schools	23.7	946	40	3	78	8%	104	11%
NJ	Brigantine School District	23.8	1,060	45	2	254	24%	254	24%
NJ	Bradley Beach School District	23.5	400	17	1	140	35%	108	27%
NJ	Westhampton Twp School Dist	23.2	511	22	2	31	6%	123	24%
NJ	Harrington Park School Dist	23.0	576	25	1	17	3%	138	24%
NJ	East Newark School District	23.0	230	10	1	69	30%	101	44%
NJ	Total		109,465	3,428	199	13,862		23,447	
NM	Rio Rancho Public School Dist	24.7	4,300	174	7	0	0%	4,257	99%
NM	Total		4,300	174	7	0		4,257	
NY	North Greenbush Common S D 4	26.0	26	1	1	0	0%	0	0%
NY	Grand Island Central Sch Dist	26.5	3,264	129	5	98	3%	131	4%
NY	Beekmantown Ctrl School Dist	23.5	2,277	97	4	364	16%	46	2%
NY	Total		5,567	227	10	483		177	
OH	Boltsville Local School Dist	170.0	340	2	1	98	29%	14	4%
OH	Harrison Hills City Sch Dist	100.7	2,517	25	8	579	23%	101	4%
OH	New Bremen School District	75.4	905	12	1	45	5%	0	0%
OH	Greenfield Exempt Vlg Sch Dist	54.4	2,283	42	7	594	26%	46	2%
OH	Willard City School District	52.3	2,299	44	6	460	20%	207	9%
OH	Clermont Northeastern District	48.0	2,302	48	4	322	14%	0	0%
OH	East Cleveland City Sch Dist	45.4	7,999	176	8	4,239	53%	7,919	99%
OH	West Liberty-Salem School Dist	41.9	1,006	24	2	50	5%	20	2%
OH	Noble Local School District	38.1	1,295	34	2	311	24%	0	0%
OH	Pymatuning Valley School Dist	37.0	1,480	40	3	400	27%	44	3%

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ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
OH	Paint Valley School District	36.6	1,243	34	4	286	23%	25	2%
OH	Union Local School District	36.3	1,707	47	6	444	26%	17	1%
OH	Liberty-Benton School District	35.8	1,002	28	1	50	5%	40	4%
OH	Heath City School District	34.7	1,250	36	3	88	7%	38	3%
OH	Jackson-Milton Local Sch Dist	34.5	1,173	34	2	211	18%	0	0%
OH	Bright Local School District	34.5	897	26	3	233	26%	0	0%
OH	Northeastern Local School Dist	34.0	3,400	100	5	136	4%	68	2%
OH	Liberty Un-Thurston Sch Dist	33.8	1,352	40	3	149	11%	0	0%
OH	Firelands Local School Dist	33.1	1,987	60	4	199	10%	20	1%
OH	Huber Heights City School Dist	31.7	8,400	265	10	756	9%	1,008	12%
OH	Caldwell Exempted Vlg Sch Dist	31.2	1,153	37	2	323	28%	0	0%
OH	Newark City School District	31.0	8,559	276	17	1,969	23%	342	4%
OH	Waterloo Local School District	31.0	1,425	46	3	171	12%	0	0%
OH	Poland Local School District	30.8	2,740	89	6	82	3%	27	1%
OH	Wilmington City School Dist	30.7	3,318	108	6	564	17%	199	6%
OH	Bethel Tate Local School Dist	30.6	2,050	67	3	349	17%	0	0%
OH	Paulding Exempted Vlg Sch Dist	30.5	2,169	71	4	239	11%	152	7%
OH	Labrae Local School District	29.8	1,669	56	4	401	24%	134	8%
OH	Cloverleaf Local School Dist	29.8	3,661	123	7	329	9%	0	0%
OH	Arcadia Local School District	29.5	650	22	1	33	5%	26	4%
OH	Western Brown Local Sch Dist	29.5	3,129	106	3	751	24%	0	0%
OH	Waverly City School District	29.2	2,072	71	4	725	35%	62	3%
OH	Montpelier School District	29.1	1,224	42	3	184	15%	12	1%
OH	Graham Local School District	28.9	2,200	76	4	242	11%	0	0%
OH	Southeastern Local School Dist	28.7	860	30	2	95	11%	17	2%
OH	North Baltimore Local Sch Dist	28.7	831	29	2	199	24%	42	5%
OH	Black River School District	28.4	1,365	48	4	164	12%	14	1%
OH	Rittman School District	28.1	1,349	48	4	391	29%	0	0%
OH	Reynoldsburg City School Dist	27.8	5,152	185	8	206	4%	464	9%
OH	Hilliard City School District	27.6	9,438	342	12	378	4%	378	4%
OH	James Garfield Local Sch Dist	27.5	1,512	55	3	166	11%	15	1%
OH	Crestview Local School Dist	27.3	1,257	46	2	201	16%	25	2%
OH	North Royalton City Sch Dist	27.3	3,900	143	5	117	3%	117	3%
OH	Southern Local School District	27.3	954	35	3	277	29%	10	1%
OH	Lakewood Local School District	26.7	2,400	90	5	480	20%	0	0%
OH	Celina City School District	26.7	4,185	157	6	419	10%	42	1%
OH	Perry Local School District	26.6	5,090	191	10	458	9%	153	3%
OH	Johnstown-Monroe Loc Sch Dist	26.6	1,252	47	4	88	7%	0	0%
OH	United Local School District	26.5	1,640	62	1	180	11%	0	0%
OH	Warren City School District	26.4	7,537	286	16	3,166	42%	3,015	40%
OH	Lexington Local School Dist	26.1	2,924	112	5	175	6%	88	3%
OH	Hubbard Exempted Vlg Sch Dist	26.1	2,400	92	3	432	18%	48	2%
OH	Xenia City School District	25.9	5,700	220	10	1,026	18%	798	14%
OH	Groveport Madison Local Dist	25.9	5,979	231	10	478	8%	478	8%

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SI	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
OH	Southwest Licking School Dist	25.8	3,019	117	5	211	7%	91	3%
OH	Weathersfield School District	25.6	1,151	45	3	242	21%	58	5%
OH	Bloom-Carroll Local Sch Dist	25.5	1,660	65	4	100	6%	0	0%
OH	Saint Marys City School Dist	25.2	2,567	102	7	257	10%	26	1%
OH	Hamilton Local School District	25.1	2,384	95	4	453	19%	143	6%
OH	Wayne Trace School District	24.8	1,338	54	3	214	16%	40	3%
OH	Georgetown School District	24.7	1,210	49	2	242	20%	36	3%
OH	Kenton City School District	24.7	2,321	94	6	557	24%	23	1%
OH	Blanchester School District	24.6	2,017	82	5	282	14%	0	0%
OH	Rock Hill Local School Dist	24.4	2,122	87	6	870	41%	21	1%
OH	Coshocton City School District	24.0	2,158	90	5	647	30%	86	4%
OH	Gallipolis City School Dist	23.9	3,034	127	4	850	28%	182	6%
OH	Lynchburg-Clay School District	23.9	1,242	52	3	261	21%	0	0%
OH	Grand Valley School District	23.8	1,311	55	5	262	20%	52	4%
OH	New Lebanon School District	23.8	1,382	58	3	138	10%	14	1%
OH	West Branch Local School Dist	23.8	2,597	109	7	364	14%	0	0%
OH	Fairland Local School District	23.8	1,882	79	3	471	25%	19	1%
OH	Greenville City School Dist	23.8	3,692	155	7	517	14%	37	1%
OH	Walnut Twp Local School Dist	23.8	714	30	2	114	16%	7	1%
OH	Bellevue City School District	23.6	2,383	101	7	334	14%	48	2%
OH	Boardman Local School District	23.5	5,146	219	7	360	7%	103	2%
OH	Goshen Local School District	23.5	2,749	117	5	440	16%	0	0%
OH	Lakota Local School District	23.5	13,237	564	14	265	2%	662	5%
OH	Green Local School District	23.4	1,379	59	4	152	11%	0	0%
OH	Buckeye Valley Local Sch Dist	23.3	2,260	97	4	158	7%	45	2%
OH	Strongsville City School Dist	23.2	5,846	252	10	58	1%	234	4%
OH	East Holmes School District	23.2	1,900	82	9	171	9%	0	0%
OH	Licking Valley Local Sch Dist	23.1	1,895	82	6	284	15%	38	2%
OH	Springfield Local School Dist	23.0	3,432	149	7	618	18%	34	1%
OH	Marietta City School District	23.0	4,007	174	8	401	10%	80	2%
OH	Total		228,616	8,197	432	35,397		18,301	
OK	Whitefield School District 10		60	0	1	31	52%	33	55%
OK	Grand View School District 34	63.0	315	5	1	236	75%	173	55%
OK	Alex Public School Dist I-56	59.8	359	6	2	133	37%	4	1%
OK	Keystone School District 15	45.5	455	10	1	155	34%	14	3%
OK	Lexington Indep School Dist 57	39.1	899	23	3	189	21%	99	11%
OK	Midwest City-Del City Sch Dist	37.8	15,533	411	28	2,951	19%	4,194	27%
OK	Lindsay Indep School Dist 9	37.5	1,200	32	3	276	23%	108	9%
OK	Jones Indep School District I9	37.1	1,075	29	3	226	21%	172	16%
OK	Hugo Indep School District I39	36.0	1,798	50	4	719	40%	791	44%
OK	Chouteau Mazie School Dist 32	34.8	870	25	4	287	33%	165	19%
OK	Liberty School District 09	32.5	65	2	1	17	26%	7	10%
OK	Jay Indep School District 1	29.9	1,586	53	3	793	50%	777	49%
OK	Tishomingo Indep Sch Dist 20	29.9	986	33	3	414	42%	187	19%

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OK	Stroud Indep School Dist 54	28.6	859	30	4	189	22%	146	17%
OK	Laverne School District I 1	28.5	485	17	2	87	18%	5	1%
OK	Inola Indep School District 5	27.9	950	34	3	57	6%	247	26%
OK	South Coffeyville District 51	27.8	333	12	2	93	28%	50	15%
OK	Frink-Chambers School Dist 29	26.7	320	12	1	64	20%	29	9%
OK	Marble City School Dist 35	26.6	186	7	1	141	76%	136	73%
OK	Keota Indep School District 43	26.3	525	20	2	268	51%	74	14%
OK	Morris School District	26.2	916	35	3	302	33%	284	31%
OK	Marlow Indep School District 3	26.2	1,334	51	3	334	25%	93	7%
OK	Waynoka Indep School Dist 3	25.0	300	12	2	63	21%	18	6%
OK	Roland Indep School District 5	24.9	1,120	45	3	361	34%	213	19%
OK	Prague Indep School Dist 103	24.7	965	39	3	270	28%	193	20%
OK	South Rock Creek Sch Dist 32	24.6	320	13	1	45	14%	22	7%
OK	Dickson Indep School Dist 77	24.4	1,100	45	4	396	36%	209	19%
OK	Bridge Creek School Dist 95	24.4	975	40	2	10	1%	20	2%
OK	Achille Indep School Dist 3	24.2	605	25	2	248	41%	139	23%
OK	Anderson School District 52	24.0	240	10	1	53	22%	62	26%
OK	North Rock Creek Sch Dist 10	23.9	455	19	1	127	28%	141	31%
OK	Wynnewood Indep School Dist 38	23.9	883	37	3	265	30%	150	17%
OK	Coweta Indep School Dist 17	23.8	2,378	100	5	499	21%	785	33%
OK	Amber-Pocasset School Dist 126	23.8	475	20	2	166	35%	29	6%
OK	Thackerville School District 4	23.8	285	12	2	94	33%	29	10%
OK	Fort Towson Indep Sch Dist 2	23.8	475	20	2	247	52%	119	25%
OK	Verdigris Indep School Dist 8	23.5	470	20	2	33	7%	89	19%
OK	Oologah-Talala School Dist I 4	23.4	1,360	58	3	136	10%	408	30%
OK	Copan Indep School District 4	23.4	445	19	2	45	10%	71	16%
OK	Osage Hills School District 3	23.3	140	6	1	22	16%	20	14%
OK	Wyandotte Indep School Dist 01	23.3	675	29	3	101	15%	209	31%
OK	Whitebead School District C 16	23.3	465	20	1	126	27%	70	15%
OK	Krebs School District 9	23.0	460	20	1	152	33%	110	24%
OK	Total		45,700	1,506	124	11,441		10,892	
OR	Black Butte School District 41		37	0	1		25%	1	4%
OR	Butte Creek School Dist 67 J	67.5	270	4	1	62	23%	30	11%
OR	Lake County School District 7	61.2	1,223	20	3	183	15%	110	9%
OR	Jefferson Co School Dist 509 J	52.7	2,950	56	6	1,121	38%	1,446	49%
OR	Stayton School District 77 J	50.4	1,058	21	4	233	22%	95	9%
OR	Sherwood School District 88 J	29.5	1,476	50	3	103	7%	44	3%
OR	Harrisburg School Dist 42 J	28.7	430	15	1	116	27%	26	6%
OR	Lacomb School District 73 C	25.2	227	9	1	59	26%	11	5%
OR	Gaston School District 511 J	25.0	900	36	3	108	12%	90	10%
OR	Grants Pass School District 7	24.9	4,848	195	8	1,309	27%	291	6%
OR	Woodburn School District 103	24.3	3,035	125	5	1,457	48%	1,335	44%
OR	Sandy Elem School District 46	23.5	2,346	100	7	422	18%	94	4%
OR	Bethel School District 52	23.5	4,363	186	8	1,178	27%	305	7%

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OR	Salem-Keizer School Dist 24 J	23.1	30,679	1,328	50	6,136	20%	3,068	10%
OR	Total		53,842	2,145	101	12,488		6,947	
PA	Phoenixville Area Sch District	77.0	3,081	40	7	185	6%	339	11%
PA	Shaler Area School District	73.0	4,963	68	7	347	7%	99	2%
PA	Oxford Area School District	58.0	2,668	46	5	320	12%	374	14%
PA	Great Valley School District	52.2	3,028	58	5	61	2%	212	7%
PA	Girard School District	44.0	1,890	43	3	151	8%	19	1%
PA	Beaver Area School District	41.1	2,299	56	3	69	3%	69	3%
PA	Easton Area School District	39.3	6,995	178	9	909	13%	1,189	17%
PA	Butler Area School District	38.6	8,490	220	14	594	7%	85	1%
PA	Cheltenham Twp School District	37.4	4,900	131	7	294	6%	1,764	36%
PA	Harrisburg City School Dist	36.8	9,228	251	16	3,230	35%	7,844	85%
PA	Albert Gallatin Area Sch Dist	36.5	3,981	109	9	1,035	26%	119	3%
PA	Chartiers Houston School Dist	35.3	1,200	34	2	96	8%	84	7%
PA	Moshannon Valley School Dist	34.8	1,218	35	2	171	14%	0	0%
PA	Seneca Valley School District	34.2	6,400	187	6	448	7%	128	2%
PA	Rose Tree Media School Dist	33.7	3,239	96	6	130	4%	292	9%
PA	Lakeland School District	33.3	1,663	50	3	166	10%	0	0%
PA	Karns City Area School Dist	32.9	1,975	60	4	119	6%	0	0%
PA	Pennsbury School District	32.4	10,496	324	14	630	6%	840	8%
PA	Norristown Area School Dist	31.2	6,400	205	13	768	12%	2,816	44%
PA	Greenville Area School Dist	30.5	1,800	59	3	90	5%	18	1%
PA	Yough School District	30.5	2,712	89	7	217	8%	27	1%
PA	Springfield School District	30.0	3,300	110	4	99	3%	264	8%
PA	Elizabeth-Forward Sch District	30.0	2,997	100	6	120	4%	90	3%
PA	Blue Ridge School District	28.8	1,324	46	2	199	15%	0	0%
PA	Red Lion Area School District	28.8	4,744	165	10	285	6%	47	1%
PA	Centennial School District	28.3	6,555	232	9	328	5%	721	11%
PA	East Penn School District	27.3	6,563	240	11	197	3%	328	5%
PA	East Allegheny School District	27.2	1,987	73	3	258	13%	258	13%
PA	Selinsgrove Area School Dist	26.7	2,724	102	7	300	11%	82	3%
PA	Clarion Limestone School Dist	26.6	1,118	42	2	112	10%	0	0%
PA	Souderton Area School District	26.4	5,554	210	9	167	3%	333	6%
PA	Panther Valley School District	26.0	1,532	59	3	138	9%	0	0%
PA	Chester Upland School District	25.9	7,288	281	12	2,332	32%	6,559	90%
PA	Glendale School District	25.8	980	38	2	137	14%	0	0%
PA	Highlands School District	25.8	3,142	122	6	408	13%	126	4%
PA	Northern Lebanon School Dist	25.7	2,415	94	5	169	7%	24	1%
PA	Scranton City School District	25.6	8,837	345	18	1,502	17%	619	7%
PA	Blue Mountain School District	25.6	2,968	116	5	297	10%	89	3%
PA	Interboro School District	25.3	3,799	150	5	342	9%	76	2%
PA	Mahanoy Area School District	25.3	1,288	51	2	167	13%	13	1%
PA	Penns Manor Area School Dist	25.2	1,310	52	2	236	18%	0	0%
PA	Montoursville Area School Dist	25.0	2,499	100	4	225	9%	0	0%

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PA	Pottsgrove School District	24.8	3,106	125	5	217	7%	280	9%
PA	Philipsburg-Osceola Area Dist	24.2	2,517	104	6	378	15%	0	0%
PA	Old Forge School District	24.0	936	39	2	75	8%	0	0%
PA	Tunkhannock Area School Dist	23.9	3,610	151	6	397	11%	0	0%
PA	Waynesboro Area School Dist	23.6	4,381	186	6	307	7%	219	5%
PA	Pine-Richland School District	23.5	2,347	100	5	70	3%	23	1%
PA	North Penn School District	23.4	11,437	488	17	457	4%	1,487	13%
PA	Steelton-Highspire School Dist	23.4	1,405	60	2	183	13%	590	42%
PA	Lakeview School District	23.4	1,475	63	3	162	11%	0	0%
PA	Indiana Area School District	23.4	3,744	160	6	262	7%	187	5%
PA	Penn Delco School District	23.4	3,248	139	6	97	3%	32	1%
PA	Kennett Cons School District	23.1	2,700	117	5	270	10%	702	26%
PA	Bermudian Springs School Dist	23.0	1,890	82	3	132	7%	57	3%
PA	Carlynton School District	23.0	1,796	78	3	162	9%	108	6%
PA	Total		206,142	6,959	347	21,216		29,632	
RI	Cranston City School District	72.5	10,083	139	24	1,311	13%	807	8%
RI	West Warwick School District	55.4	4,099	74	7	697	17%	246	6%
RI	North Providence School Dist	32.2	3,409	106	9	273	8%	205	6%
RI	Newport Public School District	26.0	3,167	122	10	855	27%	760	24%
RI	Smithfield School District	25.0	2,600	104	6	156	6%	52	2%
RI	Burrillville School District	24.5	3,061	125	6	398	13%	0	0%
RI	South Kingston School District	24.5	3,624	148	7	362	10%	326	9%
RI	Woonsocket School District	24.5	7,174	293	15	2,296	32%	1,291	18%
RI	Bristol Warren Reg School Dist	23.5	3,988	170	12	678	17%	80	2%
RI	Total		41,205	1,281	96	7,025		3,766	
SC	Barnwell County School Dist 45	54.4	2,720	50	3	1,034	38%	1,197	44%
SC	Georgetown County School Dist	34.0	10,811	318	19	5,406	50%	6,270	58%
SC	Oconee County School District	29.6	10,017	338	22	2,304	23%	1,202	12%
SC	Marion County School Dist 3	25.4	686	27	3	501	73%	652	95%
SC	Horry County School District	25.1	26,300	1,049	37	10,520	40%	7,627	29%
SC	Abbeville County School Dist	25.0	3,852	154	11	1,425	37%	1,733	45%
SC	Orangeburg County Sch Dist 3	25.0	3,296	132	6	2,373	72%	2,802	85%
SC	Fort Mill School District 4	24.2	3,000	124	5	420	14%	330	11%
SC	Lee County School District	24.1	4,143	172	8	2,983	72%	3,522	85%
SC	Total		64,825	2,364	114	26,965		25,334	
SD	Belle Fourche School Dist 9-1	23.1	1,408	61	5	183	13%	70	5%
SD	Total		1,408	61	5	183		70	
TN	Lincoln County School District	44.6	4,686	105	9	843	18%	234	5%
TN	Union County School District	42.2	2,700	64	5	756	28%	0	0%
TN	Morgan County School District	40.5	3,200	79	7	960	30%	0	0%
TN	Dayton City School District	37.5	675	18	1	176	26%	88	13%
TN	Washington Co School District	37.3	8,400	225	12	1,176	14%	84	1%
TN	Jackson-Madison Co Board of Ed	36.1	13,558	376	22	3,254	24%	3,661	27%
TN	Etowah City School District	35.0	350	10	1	60	17%	14	4%

Districts with "Greatest Need for Educational Technology"
By State
Prepared by Quality Education Data, Inc

ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
TN	Grainger County School Dist	33.6	3,089	92	7	741	24%	0	0%
TN	Cumberland Co. School District	33.4	8,181	185	9	1,792	29%	0	0%
TN	Marshall County Board of Educ	33.3	4,000	120	7	440	11%	400	10%
TN	Bledsoe County School District	33.2	1,660	50	5	448	27%	50	3%
TN	Knox County School District	33.0	52,267	1,585	86	5,227	10%	5,749	11%
TN	Maury County School District	32.7	11,199	342	16	2,016	18%	2,352	21%
TN	Rutherford County School Dist	32.4	19,800	611	26	1,584	8%	1,980	10%
TN	Henderson County School Dist	31.1	4,012	129	9	762	19%	361	9%
TN	Sevier County School District	31.1	10,105	325	20	1,718	17%	0	0%
TN	Polk County School District	31.0	2,324	75	6	511	22%	0	0%
TN	Warren County School District	30.9	6,328	205	10	1,203	19%	380	6%
TN	Hickman County School District	30.0	3,000	100	5	300	10%	90	3%
TN	Houston County School District	30.0	1,500	50	3	255	17%	75	5%
TN	Hawkins County School District	29.3	6,823	233	16	1,298	19%	68	1%
TN	McMinn County School District	29.2	7,040	241	10	1,126	16%	352	5%
TN	Williamson County School Dist	28.9	13,014	450	22	1,041	8%	651	5%
TN	Humphreys County School Dist	28.3	3,001	106	6	380	13%	90	3%
TN	Henry County School District	27.4	3,429	125	7	480	14%	308	9%
TN	Claiborne Board of Education	27.1	4,524	167	12	1,538	34%	45	1%
TN	Manchester City School Dist	26.9	1,210	45	3	194	16%	61	5%
TN	Rhea County School District	26.1	4,275	164	5	941	22%	128	3%
TN	Blount County School District	25.8	10,267	399	18	1,337	13%	103	1%
TN	Rogersville City School Dist	25.2	630	25	1	139	22%	38	6%
TN	Lauderdale County School Dist	25.2	5,080	201	6	1,417	28%	2,075	41%
TN	Humboldt City School District	24.6	2,455	100	5	737	30%	1,154	47%
TN	Newport City School District	24.1	770	32	1	270	35%	23	3%
TN	Macon County School District	23.9	3,351	140	6	469	14%	0	0%
TN	Bedford County School District	23.9	6,626	277	10	994	15%	861	13%
TN	Sumner County School District	23.6	20,414	859	35	1,837	9%	1,633	8%
TN	Gibson County Special Sch Dist	23.6	2,126	90	6	404	19%	234	11%
TN	McNairy County Board of Educ	23.4	4,031	172	8	847	21%	363	9%
TN	Jefferson County School Dist	23.3	5,580	239	10	1,116	20%	167	3%
TN	Chester County School District	23.2	2,323	100	6	441	19%	348	15%
TN	Pickett County School District	23.1	810	35	2	300	37%	0	0%
TN	Total		266,815	8,946	461	41,535		24,220	
TX	Spearman Indep School District	160.0	800	5	3	184	23%	192	24%
TX	Saint Jo Indep School District	89.3	357	4	2	136	38%	29	8%
TX	Lovejoy Indep School District	53.5	535	10	1	5	1%	16	3%
TX	Goose Creek Cons Ind Sch Dist	40.6	18,510	456	25	4,813	26%	8,515	46%
TX	Poth Indep School District	38.0	760	20	3	144	19%	319	42%
TX	Clint Indep School District	30.6	5,200	170	7	1,508	29%	4,056	78%
TX	Leonard Indep School District	28.5	712	25	3	171	24%	93	13%
TX	Harts Bluff School District	26.8	402	15	1	64	16%	24	6%
TX	Iowa Park Cons Indep Sch Dist	26.6	1,992	75	4	319	16%	40	2%

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Districts with "Greatest Need for Educational Technology"
By State
Prepared by Quality Education Data, Inc.

ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
TX	Carroll Indep School District	26.0	3,017	116	5	60	2%	91	3%
TX	Crosby Indep School District	25.9	3,700	143	6	740	20%	1,295	35%
TX	Presidio Indep School District	25.7	1,210	47	4	1,029	85%	1,174	97%
TX	Splendora Indep Sch District	25.3	2,104	83	4	589	28%	105	5%
TX	Needville Indep School Dist	25.3	2,050	81	4	410	20%	636	31%
TX	Lamar Indep School District	25 3	13,207	523	21	4,887	37%	8,056	61%
TX	Harlingen Cons Indep Sch Dist	25.3	15,605	618	22	8,895	57%	12,952	83%
TX	Oakwood Indep School District	23.9	358	15	2	204	57%	172	48%
TX	City View Indep School Dist	23.6	780	33	1	242	31%	179	23%
TX	Abbott Indep School District	23.5	235	10	1	52	22%	2	1%
TX	Palestine Indep School Dist	23.1	3,866	167	8	1,353	35%	1,662	43%
TX	Total		75,400	2,616	127	25,804		39,607	
VA	Lunenburg County School Dist	66.4	2,188	32	4	503	23%	1,028	47%
VA	Vaince Edward Co. Pub Sch Dist	62 3	2,677	43	3	723	27%	1,526	57%
VA	Amherst County School District	37.0	4,549	123	10	546	12%	1,228	27%
VA	Pittsylvania County Sch Dist	36.2	10,144	280	21	2,029	20%	3,956	39%
VA	Mecklenburg County School Dist	33.2	5,078	153	11	1,270	25%	2,387	47%
VA	Westmoreland County Sch Dist	33.0	2,177	66	5	588	27%	1,263	58%
VA	Essex County School District	31 1	1,586	51	3	301	19%	793	50%
VA	Shenandoah County School Dist	30.9	5,104	165	12	612	12%	153	3%
VA	Northampton Co School District	30.9	2,500	81	4	800	32%	1,550	62%
VA	Suffolk City School District	30.4	9,500	313	15	2,185	23%	5,130	54%
VA	Clarke County School District	28.9	1,645	57	5	148	9%	230	14%
VA	Montgomery Co. School District	27.8	9,411	339	20	941	10%	471	5%
VA	Nelson Company School District	26.6	2,050	77	6	492	24%	636	31%
VA	Petersburg City School Dist	25.4	6,061	239	9	1,703	28%	4,561	75%
VA	Alleghany Highlands Sch Dist	24.9	3,158	127	8	316	10%	126	4%
VA	Fluvanna County School Dist	23.4	2,462	105	6	591	24%	886	36%
VA	Colonial Beach School District	23.2	603	26	1	169	28%	90	15%
VA	Patrick County School District	23 1	2,681	116	7	322	12%	295	11%
VA	Total		73,594	2,393	150	14,238		26,309	
VT	Mount Anthony High Sch Dist 14	272.1	1,905	7	2	191	10%	0	0%
VT	Newbury School District	165.0	165	1	1	45	27%	3	2%
VT	Coventry School District	125 0	125	1	1	60	48%	0	0%
VT	Mount Mansfield H S Dist 17	113.6	1,704	15	3	153	9%	17	1%
VT	Burke School District	105 0	210	2	1	65	31%	4	2%
VT	Derby School District	93 2	559	6	1	145	26%	11	2%
VT	Saint Albens Town School Dist	75.1	751	10	2	150	20%	30	4%
VT	Lamoille Un High Sch Dist 18	74.3	743	10	1	111	15%	7	1%
VT	Vershire School District	72.0	72	1	1	17	24%	1	1%
VT	Morgan School District	69.0	69	1	1	19	27%	0	0%
VT	Oxbow Un High School Dist 30	65.6	525	8	1	47	9%	5	1%
VT	Jericho School District	57 3	344	6	1	17	5%	7	2%
VT	Bennington Inc School District	56 6	1,416	25	4	156	11%	14	1%

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Districts with "Greatest Need for Educational Technology"
By State
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ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I Students	Pct.	Multicultural Students	Pct.
VT	Duxbury School District	54 5	109	2	1	28	26%	4	4%
VT	Norwich School District	48 9	489	10	1	39	8%	0	0%
VT	Lowell School District	45 0	90	2	1	41	46%	0	0%
VT	North Country High Sch Dist 22	38.4	1,345	35	2	282	21%	0	0%
VT	Randolph High School Dist 02	36 3	545	15	1	202	37%	11	2%
VT	Isle La Motte School District	36 0	36	1	1	17	47%	0	0%
VT	Craftsbury School District	35.0	210	6	2	17	8%	0	0%
VT	Woodstock Un High Sch Dist 04	34 6	450	13	1	32	7%	5	1%
VT	Newport City School District	33.6	403	12	2	153	38%	4	1%
VT	Braintree School District	32.5	130	4	1	23	18%	0	0%
VT	Pittsford School District	32 0	320	10	1	48	15%	0	0%
VT	Middlebury Un High Sch Dist 03	32.0	1,055	33	2	95	9%	11	1%
VT	West Rutland School District	31 5	535	17	1	91	17%	5	1%
VT	Bridport School District	31.0	155	5	1	54	35%	0	0%
VT	East Montpelier H S Dist 32	30.8	801	26	1	72	9%	0	0%
VT	Newark School District	30.0	60	2	1	14	24%	0	0%
VT	North Bennington Inc. Sch Dist	29 2	175	6	1	26	15%	0	0%
VT	Brattleboro School District	28.9	1,010	35	5	131	13%	40	4%
VT	Orwell School District	28.5	171	6	1	27	16%	0	0%
VT	Franklin School District	28.0	140	5	1	25	18%	10	7%
VT	Northfield School District	25.7	797	31	3	64	8%	16	2%
VT	Newport Town School District	25.4	203	8	1	91	45%	0	0%
VT	Westminster School District	25.1	326	13	2	42	13%	7	2%
VT	Black River Union Sch Dist 39	25 0	250	10	1	28	11%	0	0%
VT	East Montpelier School Dist	25.0	250	10	1	25	10%	0	0%
VT	Rockingham School District	24.9	497	20	4	70	14%	0	0%
VT	Rutland City Super Sch Dist 40	24.1	2,696	112	8	377	14%	54	2%
VT	Dummerston School District	23.8	214	9	2	15	7%	0	0%
VT	Richmond School District	23 7	356	15	1	43	12%	7	2%
VT	Middlesex School District	23 3	186	8	1	30	16%	0	0%
VT	Blue Mountain Unif Sch Dist 21	23.1	600	26	1	144	24%	0	0%
VT	Johnson School District	23.0	276	12	1	86	31%	0	0%
VT	Washington School District	23.0	138	6	1	37	27%	3	2%
VT Total			23,606	618	75	3,647		276	
WA	Pioneer School District 402	31.4	817	26	2	65	8%	82	10%
WA	Fife School District 417	28 8	2,450	85	4	196	8%	294	12%
WA	White River School Dist 416	25.3	3,270	129	7	327	10%	164	5%
WA	Highline School District 401	23 3	17,943	771	33	1,435	8%	4,845	27%
WA Total			24,480	1,011	46	2,024		5,384	
WI	Silver Lake Salem J 1 Sch Dist	38 2	535	14	1	86	16%	5	1%
WI	Delavan-Darien School District	30 4	2,398	79	5	432	18%	384	16%
WI	Tri-County School District	30 3	789	26	2	213	27%	103	13%
WI	Hartford Union H S District	28 6	1,430	50	1	72	5%	29	2%
WI	School Dist of Fort Atkinson	25 9	2,638	102	5	264	10%	53	2%

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Districts with "Greatest Need for Educational Technology"
By State
Prepared by Quality Education Data, Inc.

ST	District Name	Students per Computer	No. Students	No. Computers	No. Schools	Title I		Multicultural	
						Students	Pct.	Students	Pct.
WI	Bruce School District	25 3	759	30	3	273	36%	23	3%
WI	New London School District	24 9	2,488	100	6	249	10%	75	3%
WI	Wausaukee School District	24 0	720	30	2	209	29%	7	1%
WI	Peshtigo School District	23 4	1,076	46	2	151	14%	0	0%
WI	Randall School District 1	23 2	673	29	1	54	8%	7	1%
WI Total			13,506	506	28	2,001		684	
WV	Monongalia County School Dist	92 1	10,311	112	29	2,372	23%	516	5%
WV	Braxton County School District	41 7	2,670	64	8	1,282	48%	0	0%
WV	Monroe County School District	27 3	2,239	82	6	784	35%	22	1%
WV	Taylor County School District	23 6	3,157	134	7	1,358	43%	0	0%
WV Total			18,377	392	50	5,794		538	
Grand Total: "Greatest Need"		28 5	4,362,479	152,943	7,635	1,122,946		1,570,550	
Total U S		11 8	43,671,928	3,689,610	82,747	10,543,267	24%	14,738,621	34%
"Greatest Need" Pct of U.S			10%	4%	9%	11%		11%	

STATEMENT OF ANNE MILLER, EDUCATION SEGMENT DIRECTOR, EASTMAN KODAK CO., ROCHESTER, NY

Senator COCHRAN. Dr. Anne Miller is next.

Dr. MILLER. Thank you, Senator Cochran and Senator Jeffords for this opportunity. My remarks will summarize my statement submitted for the record.

I am Anne Miller, director of the education segment in the Digital and Applied Imaging Division of the Eastman Kodak Co. Our headquarters are in Rochester, NY, and we manufacture thousands of film and digital imaging products.

Last week we unveiled a sweeping vision for the future of digital imaging, by making a series of announcements aimed at one objective, to let everyone work with pictures easily and inexpensively.

A rapidly changing global environment, technology advances in the marketplace, and the requirements of our customers make it imperative that we continuously update the skills of Kodak people.

Education and development for every Kodak employee help us achieve improved customer satisfaction, employee satisfaction, and better financial results.

To that end, we have established a goal of a minimum of 40 hours in the development of each employee every year. Now, the less time that we spend on those 40 hours teaching basic skills, the more time we will have to build competitive skills.

Last year at Kodak, the readability of 2,000 job applicants was tested. We found 25 percent reading below the eighth grade reading level.

Our basic corporate communications vehicle, the Kodakary, is written at the 10th grade reading level, and critical safety documents are generally written at the junior high level. But we do not want to be in the business of remedial education.

Current education reform initiatives emphasizing higher standards depend, in part, on technology for implementation, as Senator Hatfield was attesting to earlier.

Distance learning, access to the vast resources of the Internet, computer-based instruction, and digital imaging information sys-

tems to manage student assessment and records are just several examples of technology critical to education reform, and the development of college or work-force-ready high school graduates.

Some States are already demonstrating leadership implementing educational reform, and others need successful models, partnership opportunities, and resources to begin to make impact.

This is where the Federal Government plays an important role. Programs, such as Goals 2000, the National Challenge Grants, Star Schools, and the Technology Preparation Education Program help foster private and public partnerships, and develop models for States and communities to learn from and emulate.

Dr. Hayes just addressed the issue of inequality, and recently, Business Week did a cover story called inequality, how the gap between the rich and poor hurts the economy. Citing economic and education trends, an argument was presented that links lower U.S. growth to inequality.

They observed that in nearly every industry, the spread of new technologies is creating the need for employees who know how to do more. If U.S. workers cannot handle this, companies will be less productive than they should be, and that is a prescription for a stunted economy.

As we have heard from so many earlier witnesses, the Federal Government can help reduce inequality in education by promoting equal access to education technology through programs that do create successful models, or stimulate partnerships, or provide resources.

And industry realizes that it, too, has an important role of partnering with schools to improve our educational system. Many companies, such as Kodak, have an even closer link, because they are able to test and utilize their technologies in schools to benefit the learning process.

Cindy Fisher is a teacher from one of our partner schools, Mainland High School, in Daytona Beach, FL, and she told us:

TECHNOLOGY

Diminishing the use of technology severely limits the development of skills, as well as restricts access to a wealth of information. Not only is technology necessary to prepare for productive roles in our society, but it also provides learning tools that aide the delivery of instruction for almost every conceivable level and learning style.

MODEL TECHNOLOGY SCHOOL

Mainland High School achieved the honor of model technology school through the hard work and dedication of their faculty, but they could not have done it without the aide of grants emanating from Federal and State government programs. As a result, Mainland now serves as a model for schools across the Nation.

At Kodak, we expect to make an investment in our employees through ongoing training, but we will be more competitive if our work force arrives well prepared.

PREPARED STATEMENT

The Federal Government plays an important role by creating successful models, stimulating partnership opportunities, and providing resources to integrate technology into our schools.

Senator Cochran, Senator Jeffords, I appreciate the opportunity to have shared Kodak's perspective this morning.

Senator COCHRAN. Thank you very much for your interesting contribution to this hearing.

[The statement follows:]

STATEMENT OF ANNE W. MILLER

Good morning, Mr. Chairman and members of the Committee. I am Anne Miller, Director of the Education Segment in the Digital and Applied Imaging Division at Kodak. Our headquarters is located in Rochester, New York. We conduct business in over 150 countries and in the United States, where we have employees in nearly every state. Kodak is an imaging company that manufactures, sells, and services thousands of consumer and professional imaging products utilizing traditional imaging as well as digital technology. Last week we unveiled a sweeping vision for the future of digital imaging, by making a series of announcements aimed at one objective: To let everyone work with pictures, easily and inexpensively.

I appreciate the Committee's invitation to appear before you to discuss the appropriate role of federal government in funding programs which support the integration of technology into the Kindergarten through twelfth grade curriculum. As requested by the Committee, I will focus my remarks on the basic academic and technological skills of entry-level workers and the challenges Kodak and other American businesses face in closing the skills gap through training and retraining programs.

Recently Kodak indicated its position on the importance of training and retraining its workers by establishing goals for employee development. We believe that investment in our employees is essential if we are to improve our business results. Education and development for every Kodak person are critical tools to help us achieve improved customer satisfaction, employee satisfaction and better financial performance.

A rapidly changing global environment, technology advances in the marketplace and the requirements of our customers make it imperative that we continuously update the skills of Kodak people. Highly skilled, knowledgeable employees are a competitive advantage.

To that end, we have established a goal of a minimum of 40 hours in the development of each employee every year. The less time we spend using those 40 hours to teach basic skills, the more time (and resources) will be available for developing competitive skills which are essential for improving our business results.

Last year at Kodak the reading ability of 2000 job applicants was tested. We found 7% reading below the fifth grade level and another 18% reading below eighth grade level. Our basic corporate communications vehicle, *The Kodakery*, is written at the tenth grade reading level, and critical safety documents are generally at the junior high reading level. We do not want to be in the business of remedial education.

Our nation's investment in Kindergarten through twelfth grade education correlates directly with America's ability to build a competitive workforce. Recently a task force led by the National Alliance of Business, the U.S. Chamber of Commerce and The Business Roundtable submitted recommendations to the National Education Goals Panel calling for "a single set of high standards aimed at enabling young people to meet the increasingly complex demands of work, education and citizenship" (*Work America*, National Alliance of Business, Vol. 12 Issue 2, February 1995). The education reform initiatives underway which will lead to those higher standards depend on technology for successful implementation. Distance learning, access to the vast resources of the Internet, computer-based instruction, and digital imaging systems to manage student assessment are just several examples of education technology critical to achieving the objectives of education reform and the development of college or workforce-ready high school graduates.

Some communities and states are already demonstrating leadership implementing educational reform plans that will raise academic standards. Others need successful models, partnership opportunities, and resources to begin to make impact. This is where the federal government plays an important role. Programs such as Goals 2000, the National Challenge Grants under the Education Technology program, Star schools, and the Tech-Prep Education program help foster private/public partnerships and develop models for states and communities to learn from and emulate.

Several months ago *Business Week* did a cover story on "Inequality: How the Gap Between Rich and Poor Hurts the Economy" (August 15, 1994 pp. 78-84). Citing economic and education trends, an argument was presented that links lower U.S. growth to inequality.

> In nearly every industry, the spread of new technologies is creating a need for employees who know how to do more. As companies reorganize, moreover, they're pushing decision-making down the ladder. If U.S. workers can't handle these changes, companies will be less productive than they should be. And that's a prescription for a stunted economy. (p. 79)

The federal government can help reduce inequality in education by promoting equal access to the benefits of education technology through programs which create successful models, stimulate partnership opportunities, or provide resources. Industry realizes it has an important role partnering with schools and communities to improve our educational system. Additionally, many companies, such as Kodak, have an even closer link because they are able to test and utilize their new technologies in schools to benefit the learning process. A teacher from one of our partner schools, Mainland High School in Florida, makes this observation:

> If our commitment is to provide quality education for America's children, we must prepare our students with the kinds of skills necessary to succeed in today's world. Diminishing the use of technology severely limits the development of those skills as well as restricts access to a wealth of research and information. Not only is technology necessary to prepare for productive roles in our society, but it also provides learning tools that aid the delivery of instruction almost every conceivable level and learning style. (Cynthia Fisher, Model Technology School Facilitator, Mainland High School, Daytona Beach, Florida).

Mainland High School achieved the honor of Model Technology School through the hard work and dedication of the students and faculty, but could not have done it without the aid of grants emanating from federal and state government programs. As a result, Mainland now serves as a model for schools across the nation.

At Kodak we expect to make a continuous investment in our employees through ongoing training and retraining, but we will be more competitive if our workforce arrives well-prepared. The federal government plays an important role by creating successful models, stimulating public/private partnership opportunities, and providing resources to integrate technology into our schools.

Mr. Chairman and members of the Committee, I appreciate the opportunity to have shared Kodak's perspective on the appropriate role of the federal government in funding programs which support the integration of technology into the Kindergarten through twelfth grade curriculum. Those programs have an impact on the basic academic and technological skills of entry-level workers, and their success helps reduce the challenges that Kodak and other American businesses face in closing the skills gap. I will be happy to answer any questions.

STATEMENT OF KATHLEEN FULTON, PROJECT DIRECTOR OF THE OFFICE OF TECHNOLOGY ASSESSMENT, WASHINGTON, DC

Senator COCHRAN. We will now hear from Ms. Kathleen Fulton, from the Office of Technology Assessment, about a study Senator Kennedy and I requested the Office to do on this subject.

Ms. FULTON. Thank you very much, Senator. It is a pleasure to be here today to discuss OTA's report: "Teachers and Technology, Making the Connection."

We are delighted that you have suggested that we release the report today with this hearing, and we thank you for your support in seeing this as an important area of study.

As you are aware, OTA has conducted a number of studies on educational technology since the 1988 study, "Power On," which

then looked at computers in schools. Since that study, a number of exciting promising advances have been made.

As we have seen here today, the hardware advances have been substantial, and there has been an increase in the numbers available in schools.

Advances in speed, power, and capabilities have been very impressive, along with the advances in software, that makes it more engaging and involving for students, making technology far more useful for education than ever before.

However, in the process that ensuring that students have access to computers, video, and other emerging technologies, we have often overlooked what may be the central piece to the educational technology equation, the teachers.

A substantial number of teachers still do not use technology regularly in the classroom. Clearly, without the involvement of teachers, the investments made in educational technologies, estimated at over $2 billion per year, are not being fully realized.

The potential of technology for education is great, but by shortchanging teachers and their important role in guiding classroom learning, we may be missing the boat. Where have we lost the connection between teachers and technology?

First, most teachers have not had adequate training and support to prepare them to use technology effectively in teaching. Most districts allocate no more than 15 percent of their technology budgets to training, yet States that have made technology an educational priority recommend a figure much higher, 30 percent, at a minimum, allocated to teacher training and support.

In addition, while most teachers have attended workshops in computer literacy or word processing, less attention has been given to the most challenging area, helping teachers integrate technology into the curriculum. Yet adopting and adapting technology to curricular goals takes time, and time is the most limited of school resources.

Furthermore, training teachers in and with technology requires support and followup assistance after the training class ends. Most teachers do not have access to equipment and materials when and where they need it.

Teachers do not routinely have computers of their own on their desks, and only one-third of all computers for instruction are located in the classroom, which means that a teacher who wants to do an activity with the students has to take a minifield trip every day, going down the hall, up the stairs, to the computer lab.

And though one-third of school buildings now report they have some level of access to the Internet, less than 3 percent of that access is in the classrooms. This is not surprising when, as we have all heard today, the problem of telephones is such that less than 12 percent of teachers have a telephone in the classroom.

But perhaps most disturbing is the fact that even our newest teachers are not entering the classroom prepared to teach with technologies. Today's college education graduates have not been taught to teach with technology.

Faculty and many teacher preparation programs are not expert or experienced with educational technologies, and thus do not model or require teaching with technology.

Many colleges of education often lack the advance technologies that their education students find when they go out in the K through 12 schools. These are troubling findings, and they suggest that lack of support to teachers could continue to hold back the potential of technology for students.

But we also saw examples of change, places where teachers are being empowered with the tools of the trade. These are discussed in detail in our report, and in a video which also accompanies the report.

For example, we saw how a simple voice mail system, like that in Webster Elementary School, in St. Augustine, FL, makes it possible for teachers to reach parents regularly with news of what is happening in the classroom, what homework is assigned, what problems a student is having, or the great things that a student may be doing.

One of the most promising findings of this study, I believe, is how technologies themselves can be powerful resources for improving professional development in all areas for teachers, changing the model from the old style one-shot, one-size-fits-all teacher training session to just-in-time training and support, using video, telecommunications networks, and other distance learning technologies, like we have seen featured here today, with the Mathline demonstration.

We saw how teacher education students share their concerns and observations with other aspiring teachers around the world on Presto, which is a telecommunications link that was started at Mississippi State University.

In the process, they come to expect that as teachers they will communicate with one another, they will have access, they will share their ideas, and find information from the world outside the classroom, which in the past has always been a locked door.

If there is promise in connecting teachers with technology, what role does the Federal Government play? As in all areas, it is limited; that of States, districts, and the colleges of education has been greater.

Nevertheless, past programs have had a significant impact in enhancing the technology skills of teachers, when this has been seen as a national need, especially in areas of mathematics, science, and special education.

Federal leadership sets the tone that technology is valued in education. Still, much of this Federal support for technology-related teacher development is optional in nature, and small in amount.

The link between effective use of technology for students and technology training for teachers has not always been made. Furthermore, we are only beginning to see leadership and support for providing this support and training through the technologies themselves.

To make the link will require attention in several areas, but does not necessarily require new legislation or new funding initiatives. There are a number of existing programs, and many of those have been referred to here today, including Star Schools, the Eisenhower Professional Development Program, the Technology in Education Act, and programs supporting equity and delivery of instruction to

meet the pressing needs of children who are disadvantaged, non-English speaking, or needing special education services.

But, again, although educational technology has been identified as an important tool for their learning, adequate professional development for their teachers to use this technology creatively has not always kept pace.

Finally, vast educational opportunities for teachers and students could be lost unless schools gain access to the emerging information infrastructure.

The telecommunications legislation under consideration by this Congress will need to consider the important and expensive question of school access to telecommunication resources.

Special needs of education could be overlooked, neglected, or shut out, unless these considerations are built into Federal, State, local, and private sector decisions on telecommunication regulations and funding over the next few years.

PREPARED STATEMENT

We suggest that if this Nation hopes to make the most of the past and continuing investments in educational technology, then making the connection between teachers and technology, helping each teacher effectively incorporate technology into the teaching process, is one of the most important steps that can be taken. Thank you.

Senator COCHRAN. Thank you very much, Ms. Fulton, for your testimony.

[The statement follows:]

STATEMENT OF KATHLEEN FULTON

It is a pleasure to be here today to discuss OTA's report, Teachers and Technology:
Making the Connection. I would like to submit the first chapter of the report, the Summary and
Policy Options. for the record. and speak this morning briefly on the major points which may be of
interest to this Committee.

As you are aware. OTA has conducted a number of studies on educational technology
since the 1988 study on computers in schools. Power On! New Tools for Teaching and Learning.
Since that study was released seven years ago. a number of developments have occurred in schools:

- *First. hardware purchases have been substantial*: During the 1980s. the numbers of computers
  for instructional use in U.S. schools grew approximately 15 percent per year. During the last
  three years. there has been an 18 percent annual growth rate. with about 700,000 more
  machines added to the K-12 inventories per year. We estimate that today there are 5.8 million
  computers for instruction in schools. almost three times the 2 million computers we reported in
  1988. Today. that translates to approximately one computer for every nine students.
- *Second. hardware developments have been impressive:* The hardware available today is
  far more powerful and diverse than ever before. with dramatic advances in speed, memory. and
  capabilities. The growth of local and wide area networks. video, CD-ROM, multimedia,
  telecommunications. and distance learning capabilities has made technology far more useful for
  education than ever before.
- *Third. software advances have been exciting:* We've moved from simple text and basic
  graphics to interactive full motion video of a quality that can compete with what students see
  on TV or in the movies.

However. in the process of ensuring that students have access to computers, video.
and other emerging technologies. we have often overlooked what may be the central piece to
the educational technology equation--the teachers.

Despite these advances in hardware and software. a substantial number of teachers still
do not use computer- and video-based technologies regularly in their classrooms. Without the
involvement of teachers. the investments made in educational technologies--estimated at over
$2 billion dollars for 1993--cannot reach their educational potential. At the center of effective use
of instructional technologies are those who oversee the daily activities of the classroom, the
teachers.

I'd like to focus my testimony today on what might be some of the reasons for this state of
affairs. then review briefly the role the federal government has played in the past, and suggest some
promising areas that offer potential for making better use of these educational investments in the
future.

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Where Have We Lost the Connection between Teachers and Technology?

First, most teachers have not had adequate training and support to prepare them to use technology effectively in teaching. A majority of teachers report feeling inadequately trained to use technology resources, particularly computer-based technologies. Most districts allocate less than 15 percent of their technology budgets for training, yet those states in which technology is an educational priority recommend that twice this figure--30 percent--be allocated to teacher training and support

Second, appropriate training means more than one-shot, one-size-fits-all sessions. While most teachers today have attended workshops in computer literacy, or been taught to use some basic applications like word-processing, less attention has been given to the most challenging area: helping teachers integrate technology into the curriculum Adopting and adapting technology to curricular goals takes time--and time is one of the most limited resources in K-12 education. Training teachers in and with technology requires support and followup assistance after the training class ends. Those of us who use technology regularly in our work know how important our "support systems" are--not just for help with technical problems, which certainly occur--but to provide assistance with applications and guidance on how and why we might want to use them. Yet very few schools have this type of technology support on hand

Third, many teachers do not have access to equipment and materials when and where they need it If they want to develop a lesson using a multimedia demonstration in social studies, or teach with graphing calculators in math, or direct a collaborative science project in which students collect data and compare it with students across town or in another country, teachers need the appropriate technology right in their classrooms. In addition, they often need access to a telecommunications network at home, where they do so much of their preparation. Yet many teachers do not have computers of their own in the classroom. Often the computers for student use are housed in labs down the hall and up the stairs. Half the computers in American schools today are older, less powerful, 8-bit machines. And, although a third of school buildings today have some level of access to the Internet, only 3 percent of instructional rooms have that access. "Instructional rooms" includes not only classrooms but computer labs and media centers, meaning that classroom access is even lower than 3 percent. This low level of access to the Internet is not surprising when we note that only one teacher in eight--approximately 12 percent of teachers--has a telephone in the classroom.

Perhaps more disturbing is the fact that even our newest teachers are not entering the classroom prepared to teach with technologies. This may be surprising to those who think of other areas--like medical education--where those in training routinely learn to work with the latest technologies of the profession. Even though today's generation of young teachers may have had exposure to technology, they have not necessarily been taught to teach *with* technology, in part because many colleges of education often lack the advanced technologies that students will later find in the schools. Many faculty in teacher preparation programs are not experienced in the potential of technologies for education, and therefore do not model technology use in their teaching.

This is the troubling picture we saw of teachers and technology But we also saw examples of change, places where teachers are being empowered with the tools of the trade.

The Potential: Selected Examples

Teachers tell us that the use of technologies can generate greater motivation and student achievement in the classroom, and better communications between the school and parents. We saw how a simple voice mail system like that in Webster Elementary School in St. Augustine, Florida makes it possible for teachers to reach parents on a regular basis with news of what is happening in class and what homework is being assigned, and to leave personal messages regarding an individual student's problems--or achievements. We have seen how video, telecommunications networks, and other distance-learning technologies make it possible to provide "just-in-time training and support" to teachers in projects like those featured here today (e g, Mathline) We watched as a teacher in rural Iowa, stimulated by the challenge of having learning disabled children mainstreamed into his classroom , took a course in teaching learning disabled students offered over the Iowa fiber optic network. This teacher sat in a classroom in his school and could see, hear, and contribute to the class being beamed around the state from the University of Northern Iowa Without the technology link, this teacher would never have been able to take the class in time for helping this year's students. He would have had to wait until his summer break to take it on campus hundreds of miles from his home Or never learn these skills at all.

In teacher preparation programs, we also saw promising approaches signaling change. These include projects like the video case studies modeling exemplary math instruction, prepared at Vanderbilt University with federal support, and PreSTO, an Internet discussion list developed at Mississippi State University as a forum for teacher education students around the world to share their concerns and experiences with one another.

The Federal Role

Your Committee today is concerned with the federal role in educational technology, and I've been asked to focus on the potential federal role for teachers and educational technologies.

In the past, the role of the federal government in teacher preparation and technology has been limited, as it has in all education activities, especially in comparison with activities by states, school districts, and colleges of education. Nevertheless, past federal programs have piloted innovative educational applications of technology for teaching and have provided significant support for professional development, especially for mathematics, science and special education teachers. Federal funds have also made it possible for teachers to take advantage of technology-related professional development opportunities in school districts that could not have supported them on their own. Support has also come through programs encouraging innovations in teaching with technology, funding the research, development, and dissemination of new applications. Our report lists a number of programs that have been influential in the past.

Despite these efforts, much of the federal support for technology-related teacher development is optional in nature and small in amount. Even if the reform bills passed last year are funded and well-implemented, federal support will continue to be provided through competitive grant programs or as part of programs with larger purposes. As a result, federal support remains highly variable from year-to-year, piecemeal in nature, and lacking in clear or consistent policy. Some support is emerging from state and local governments and the private sector, but that support is often subject to changes in political agendas, state budgets, and inclinations of the private sector.

This situation could be improved in both the public and private sectors. In the public sector, both continuing congressional support and executive branch implementation may be necessary. If recent legislation is implemented with the goal of improving connections between teachers and technology, the following programs are likely to be influential:

- The Star Schools Program, if increased focus is given to teacher professional development as well as student instruction over these networks.
- The Eisenhower Professional Development program, extending professional development beyond mathematics and science into other content areas.
- The Technology in Education Act, which could be the centerpiece of a stronger federal role in a number of areas including: developing a long range technology plan for the nation's schools; providing technology related teacher development; improving students' and teachers' access to technology; and developing, evaluating, and disseminating promising educational applications through such programs as the proposed Technology Challenge Grants;

- Programs such as Title I of the Elementary and Secondary Education Act for disadvantaged students, the Individuals with Disabilities Education Act, and the Bilingual Education Act are areas where the link between teachers and technologies also could be strengthened.

As you know, Congress is considering rescissions that could affect these programs during the current fiscal year, and this committee hearing is related to their funding for fiscal year 1996.

Congress is also considering legislation regarding telecommunications regulations that could have a tremendous impact on schools' and teachers' access to new means of communication and information gathering. Full consideration of the potential impact of different federal telecommunications regulations was beyond the scope of OTA's report on teachers and technology. Clearly, however, legislation that would help schools gain access to the emerging information infrastructure could provide critical resources and access to broader professional development opportunities for teachers, as well as resources for students. Providing these connections may be financially difficult for schools: it has been a challenge for school districts and state education authorities. Some states have developed creative approaches to seeing that schools get affordable access to new telecommunications technologies: these approaches might provide models for federal legislation.

Conclusion

Mr. Chairman, I believe it is the goal of the American education system to assure that all our children will receive a high quality education appropriate for the information age in which they will live and work. We cannot promise that this will magically occur if every teacher has access, training, and support for integrating promising new technologies into curricula. But we suggest this is a key factor that has been overlooked in the past. The technologies available to educators are changing very quickly, and the promise they offer for professional development, parent-teacher communication, student achievement, and administrative efficiencies have yet to be fully evaluated. What our report suggests is that it is likely to be worthwhile to provide some additional federal support--both leadership and funding--to the states, districts, schools and teachers who are ready to experiment with new technologies that appear promising for classroom use. The report also suggests that the private sector--which has developed and benefited from the use of those technologies in classrooms--could play a more active role in assisting in the integration of technologies into the classroom and teachers' professional lives. These actions could be critical to making the connection between teachers and technology.

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GENERAL ACCOUNTING OFFICE

STATEMENT OF LINDA MORRA, DIRECTOR OF EDUCATION AND EMPLOYMENT ISSUES, GENERAL ACCOUNTING OFFICE

Senator COCHRAN. I am going to ask Dr. Morra to come down on the other end of the witness table, so I can see you. I know you are there.

Ms. MORRA. Yes.

Senator COCHRAN. Dr. Morra is the Director of Education and Employment Issues at the General Accounting Office. There has been a study, also done by GAO, that will be released today on school facilities and the availability of technology. Dr. Morra will tell us about that.

Welcome.

Ms. MORRA. Thank you. I think as close to the last speaker, or as the last speaker, I am going to be very brief.

I think that the results of GAO's study complement and echo much of what you have heard today. You asked us here today to focus on the latest report on our national survey of 10,000 schools and visits to 10 school districts concerning whether America's schools have appropriate technologies such as computers, and the facility infrastructure to support the new technologies.

In brief, we found that overall the Nation's schools are not even close to meeting their basic technology needs. Most schools do not fully use modern technology, and not all students have equal access to facilities that can support education into the 21st century, even those attending schools in the same district.

Let me expand. You have heard a lot about what a school might look like for the 21st century. It would not look any more like the schools that we know that had uniform-size classrooms, with rows of desks, a chalkboard at one end, and textbooks.

Rather, schools prepared to support the 21st century would have flexible space, including space for small- and large-group instruction. They would have space to store and display alternative student assessment materials.

They would have facilities for teaching lab science, including demonstration and student lab stations, and they would have a media center, with multiple network computers to access information from outside libraries and information sources.

But in addition, schools would also have enough high-quality computers, some with CD–ROM, printers, and computer networks for instructional use, modems, telephone lines for modems, and telephones and instructional areas, TV's, VCR's, laser disc players, cable TV, fiberoptic cable, conduits for computer, and computer network cables, electrical wiring, and power for computers and other communications technology.

Today, our survey results indicate that we only have a handful of schools, mainly science high schools, like one in Virginia, the

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Thomas Jefferson High School, which can act as models of state-of-the-art communication technologies.

School officials reported that about 10.3 million students and about 25 percent of the Nation's schools do not even have sufficient computers. Although at least three-quarters of schools reported having sufficient computers and TV's, we think that on the computer end, that this is an overestimate.

And while they reported this, they do not have the system or the building infrastructure to fully use what they do have.

For example, almost one-half of the schools reported insufficient electrical wiring for computers or for computer communication technology. Over one-half of America's schools report insufficient capability in modems, in phone lines, and in conduits.

Because computers and other equipment are often not networked, or connected to any other computers in the school, or the outside world, they cannot access the information super-highway.

Specifically, most schools have computers and TV's, but little infrastructure to fully utilize them. Far from the high-tech world of interactive media and virtual reality, many of our schools are wired for no more than film projectors.

One school told us they use a computer bus, for example, a high-tech version of the old bookmobile, to meet the technology requirements of their six elementary schools.

Our information shows that not all students have equal access to facilities that can support education into the 21st century, even those attending schools in the same districts.

Overall, schools in central cities and schools with a 50 percent or more minority population were more likely to have insufficient technology elements.

Technology infrastructure has the potential to link even the most remote or the poorest school with vast resources. It can link them with our finest teachers and the best libraries, but our survey results indicate that this potential is far from realized.

PREPARED STATEMENT

In particular, older, unrenovated schools need infrastructure renovation to support technology. What remains unclear, however, is how to fund this extensive infrastructure renovation. That concludes my comments.

Senator COCHRAN. Thank you very much. We appreciate your being here, Dr. Morra. We appreciate all of this testimony we have gotten from this panel.

[The statement follows:]

STATEMENT OF HON. LINDA G. MORRA

Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to assist you as you examine the federal role in programs that support technology integration into the public school curriculum.

In educating America's children for a technological world, schools must have the infrastructure in place before technology can be fully integrated into the curriculum. Schools, school districts, and states--as well as the federal government--struggling with the large investment required for this to materialize. Fiscal constraints and the rapidly changing nature of technology make this a particularly difficult issue.

You asked us to focus today on the findings of our recently completed national survey of school facilities[1] concerning whether America's schools have appropriate technologies, such as computers, and the facility infrastructure to support these technologies. We have just issued another report on our survey that addresses how well America's schools are designed and equipped for the 21st century.[2] More specifically, our remarks will address (1) the need for technology in our nation's schools and (2) problems that schools report having in meeting those needs. Our perspective resulted from our survey of a nationally representative stratified random sample of about 10,000 schools, which we augmented with visits to 10 selected school districts.

In summary, we found that, overall, the nation's schools were not even close to meeting their basic technology needs. Most schools do not fully use modern technology, and not all students have equal access to facilities that can support education into the 21st century, even those attending school in the same district.

TECHNOLOGY NEEDS FOR AMERICA'S SCHOOLS

What would a school ready for the 21st century look like? After discussions with experts and reviews of the literature, we determined that rather than uniform-sized classrooms with rows of desks, a chalkboard, and minimal resources such as textbooks and encyclopedias, schools prepared to support 21st century education would probably have

-- flexible space, including space for small- and large-group instruction;

-- space to store and display alternative student assessment materials;

-- facilities for teaching laboratory science, including demonstration and student laboratory stations, safety equipment, and appropriate storage space for chemicals and other supplies; and

-- a media center/library with multiple, networked computers to access information to outside libraries and information sources.

In addition, schools would probably have enough high-quality computers, some with CD-ROMs (compact disk read-only memory), printers, and computer networks for instructional use; modems;

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[1] See School Facilities: Condition of America's Schools (GAO/HEHS-95-61, Feb. 1, 1995).

[2] School Facilities: America's Schools Not Designed or Equipped for the 21st Century (GAO/HEHS-95-95, Apr. 4, 1995).

telephone lines for modems and telephones in instructional areas; television (TV) sets; laser disk players/video cassette recorders (VCR); cable TV; fiber optic cable; conduits/raceways for computer and computer network cables; electric wiring; and power for computers and other communications technology.[3] Networking capability in the classroom allows for use of a wide range of teaching and learning strategies that are not possible with stand-alone computers. For example, networks allow

-- groups of students simultaneous access to large data sources;

-- students to communicate with each other, with teachers, and with teachers and students in other schools; and

-- teachers to interact with students by computer as students work--engaging in online dialogs, referring to additional resources--or students to engage in group projects.

Although technology is changing constantly and quickly becoming defined by complex interactive and multimedia[4] technologies and standards are only beginning to emerge,[5] it helps to regard school communications technology as comprising four basic electronic systems: technology infrastructure, data, voice, and video. These systems transmit data--by computer networks, voice--by phone lines, and video--by TV, within the school, among different school buildings, to the outside world, and even to outer space. For a more detailed explanation of these systems, see appendix I.

State-of-the Art-Schools Are Few

Today, new schools are being designed with these changes in mind. Yet the nation only has a handful of such schools--mainly science high schools like Stuyvesant High School in New York City, or Thomas Jefferson High School in Virginia--that model state-of-the-art communications technologies. However, to prepare the nation's children and teenagers to be competitive as workers in the 21st century, experts and business leaders say modern communications technologies need to be part of America's elementary and secondary education, not just the sole province of a few special schools.

An example of state-of-the-art technology is found in Stuyvesant, the new science high school. Serving about 3,000 students, it has over 400 computers, most of which are arranged in 15 networks, with access to the Internet, as well as four antennae on the roof to communicate with satellites and virtually anyone else in the outside world. This school has the ability to directly access the latest information from the most sophisticated scientific satellites, and participate in interactive "classes" with scientists in the field in the Amazon rain forest via interactive, multimedia networks like the JASON Project. This allows the students to talk with these scientists and observe them and the rain forest on their TV screens during regular class time, allowing them to go worldwide on "virtual" field trips.

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[3] Experts have identified other key components affecting the implementation of technology in schools, such as sufficient teacher training and computer support services. However, because our focus was on school facilities, these components were not included in our survey.

[4] Multimedia uses a single communication system (cable) to transmit voice, data, and video, currently by digitizing voice and video.

[5] See, for example, The National Information Infrastructure: Requirements for Education and Training, National Coordinating Committee on Technology in Education and Training, (Alexandria, Va: 1994).

## MOST SCHOOLS DO NOT FULLY USE MODERN TECHNOLOGY

Although at least three-quarters of schools reported having
sufficient computers and televisions, they do not have the system
or building infrastructure to fully use them. Moreover, because
computers and other equipment are often not networked or connected
to any other computers in the school or the outside world, they
cannot access the information super highway. Specifically,
most schools have computers and TVs but little infrastructure to
fully use technologies. Some of our respondents made very pointed
comments about this:

"We live in a state where we put more technology and safety in an automobile than
we do in our schools."

"We are not ready to join the information network proposed by Vice President
Gore."

In response to our survey questions, over two-thirds of the
schools reported having sufficient computers, printers, TVs, laser
disk players/VCRs,[6] and cable TV.[7] However, school officials report
that about 10.3 million students in about 25 percent of the schools
do not have sufficient computers. Although most schools report
having sufficient numbers of computers and other basic technology
elements, they do not have the technology infrastructure to fully
use them. (See fig. 1 and table 1.)

Figure 1: Most Schools Report Sufficient Computers and Televisions but Lack of Infrastructure to Fully Use Technology
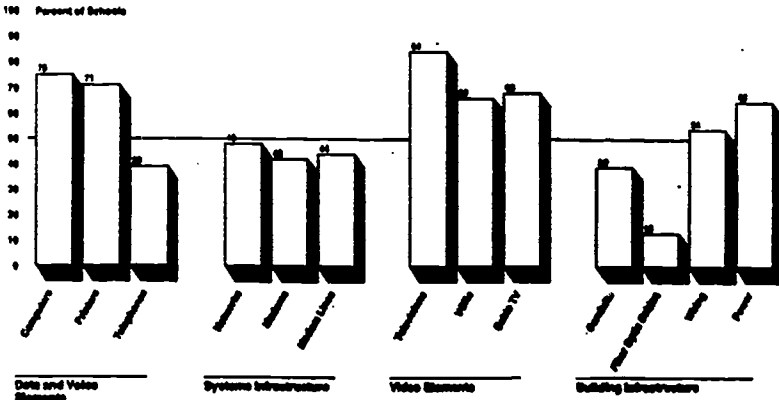
[6]Laser disk players and VCRs were rated as one item. It could be
that there are a sufficient numbers of VCRs but not laser disk
players.

[7]The self-reports of sufficiency may be overly optimistic for
several reasons. First, in our analyses we included as
"sufficient" responses that indicated moderately and somewhat
sufficient capability, as well as very sufficient capability. This
could indicate a wide range of sufficiency, including some
responses that are very close to "not sufficient." Second, our
analysis of responses showed that without any objective standards
with which to anchor their responses, schools indicating
"sufficient" computers had computer student ratios that ranged from
1:1 to 1:292 (a median of 1:11) for those schools that had
computers. About 300 schools that indicated they had no computers
said that was sufficient. (See table III.9.) Finally, technology
experts who regularly consult with school systems report that the
level of knowledge among school administrators and staff of
possible use and application of technology in schools is low--
further increasing the likelihood that these sufficiency estimates
are overly optimistic.

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Table 1: Millions of Students Attend Schools Reporting Insufficient Capability to Support Technology

Technology element	Percent of schools	Number of schools	Number of students affected (in millions)
Fiber optics cable	86.8	66.000	35.4
Phone lines for instructional use	61.2	47.000	24.6
Conduits/raceways for computer/computer network cables	60.6	46.600	24.9
Modems	57.5	44.200	23.0
Phone lines for modems	55.5	42.700	22.5
Computer networks for instructional use	51.8	40.100	20.7
Electrical wiring for computers/communications technology	46.1	35.700	19.3
Electrical power for computers/communications technology	34.6	26.900	14.5
Laser disk player/VCR	33.5	25.700	13.5
Cable TV	31.7	24.200	12.2
Computer printers for instructional use	29.3	22.700	11.9
Computers for instructional use	25.2	19.500	10.3
TVs	15.9	12.200	6.8
Schools reporting six or more insufficient technology elements	51.9	40.400	21.3

Even in those schools reporting sufficient number of computers, over one-third reported insufficient electrical wiring for computers/communication technology. Computers and other equipment that are not networked or connected to anything else in the school or in the outside world may be sufficient for basic or reinforcement activities, but they are limited in their access to the vast amount of electronic information available and do not allow for new information to enter the system or for the interaction between students, students and teachers, or the school and the outside world.

Over half of America's schools report insufficient capability in modems, phone lines for modems, phone lines for instruction, conduits/raceways, and fiber optics:

-- In central cities, over 60 percent of schools report insufficient networks, modems, phone lines (for modems or instruction), conduits and fiber optic cables. Over half report insufficient capability for electrical wiring for computer technology.

-- Schools with inadequate buildings' also were more likely to report insufficient capability to support technology. In every area of communications technology we asked about, schools with no inadequate buildings reported greater sufficiency than schools with one or more inadequate buildings. However, even in schools reporting no inadequate buildings, about one-half or more reported insufficient capability in areas related to interconnectivity, such as networks, modems and fiber optics.

Far from the high-tech world of interactive media and virtual reality, many of our schools are wired for no more than film projectors. One school district told us they use a computer bus--a high-tech version of the 1950s bookmobile--to meet the technology requirements of their six elementary schools. Many other issues are also important to the use of technology in our schools--such as teacher training and computer support services--but we did not ask about these in our survey. As one respondent commented,

"We need technology in the schools and teachers who can use the equipment. The percentage of teachers who can use computers is

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'We asked respondents to rate the overall condition of their school buildings on a 6-point scale: excellent, good, adequate, fair, poor, or replace. See School Facilities: Condition of America's Schools (GAO/HEHS-95-61, Feb. 1, 1995).

abysmally low, yet computers only scratch the surface of technology that should be available to all students, not just those who live in affluent areas. Interactive TV and telecommunications is a must in all schools, yet the cost of this technology remains prohibitively high for most small schools. For those schools who can afford it, the cost of training teachers to use it drives the costs up further."

Not All Students Have Equal Access to Technology

Our information shows that not all students have equal access to facilities that can support education into the 21st century (see table 1), even those attending school in the same district. Earlier we spoke about the state-of-the-art Stuyvestant High School. Only a few blocks away, we saw an example of one of the worst high schools in New York City. Overall, schools in central cities and those with a 50-percent or more minority population were more likely to have more insufficient technology elements than other schools. Several of our survey respondents made very pointed comments about the limitations of their computer technology:

"Our computers are mostly donated. What few we purchased were bought in 1984--the kids laugh at them, they have better at home."

"Facility adaptation for computer networks, video networks, and phone access is expensive and makes justifying purchase of computer hardware more difficult."

Our survey results were reflected in our site visits. Following are some observations made during our visits:

-- In Ramona, California, the two schools that were built in the past five years are wired for the latest technology. We learned, however, that some older schools needed to retrofit wiring to increase power for more demanding technologies; one elementary school had only two outlets in each classroom. If four teachers used their outlets at the same time, the circuit breakers tripped. This happened about once a month.

-- A similar situation exists in Montgomery County, Alabama. New schools are designed to meet technology needs. However, one school official in said that new electrical systems were the most common renovation needed at most schools to accommodate computers and other technologies.

-- In Chicago, new schools, like the Andrew Jackson Language Academy built in 1989, have and use computers because it has the infrastructure necessary for technology. In contrast, at another school we visited in Chicago, computers were still in boxes because they did not have sufficient power and outlets to use them.

Many education reformers say that it is unfair to hold students to nationwide standards if they have not had an equal--or roughly equal--opportunity to learn. If schools cannot provide students with sufficient technological backup or with sufficient facilities for instruction and services, they may not be providing even a roughly equal opportunity for all students to learn. This is particularly true in central cities and in schools that serve high percentages of minority and poor students.

CONCLUSION

Most of America's schools do not yet have key technologies or the facilities required to support learning into the 21st century. In particular, older, unrenovated schools need infrastructure renovation to support technology. What remains unclear, however, is how to fund the infrastructure renovation. I would be happy to answer any questions you may have.

APPENDIX I
COMMUNICATIONS TECHNOLOGY IN SCHOOLS

Although technology is changing constantly and quickly becoming defined by complex interactive and multimedia[9] technologies and standards are only beginning to emerge,[10] it is helpful to regard school communications technology as comprising four basic electronic systems: technology infrastructure, data, voice, and video.

TECHNOLOGY INFRASTRUCTURE

Of the four systems, technology infrastructure may be the most important and least understood. Data, voice, and video systems cannot operate without either the building infrastructure or the system infrastructure necessary to support them. Building infrastructure consists of what needs to be built into the facility to make technology operate effectively throughout the school--the conduits/raceways through which computer and computer network cables are laid in the school, the cables and electrical wiring for computers and other communications technology, and the electrical power and related building features such as electric outlets. It is relatively easy and inexpensive to design a new building with this infrastructure included; installing this infrastructure in existing buildings can be expensive and disruptive to the educational process.

The other type of infrastructure--system infrastructure--links up various components of the technology. For example, computer network infrastructure consists of the software that actually runs the networking function--linking all the computers in a class or in the school or the computers in the school with computers in the outside world--as well as pieces of hardware like servers--the special computers with large information storage capabilities that allow many users to share information--whose purpose is to make the network work. Besides the network infrastructure, modems--small electrical devices that allow computers to communicate with each other through the phone lines--are another basic component of systems infrastructure that links data, voice, video, and even multimedia systems.

This technology infrastructure, although initially more costly than the basic computer/printer, has potentially substantially more value. Educationally, it can link even the most remote or poor school with vast resources, including the finest libraries and the best teachers for a wide range of courses or course enhancements, like "virtual" field trips. Financially, according to the North Central Regional Educational Laboratory, the Internet and the emerging video and imaging technologies could be used to change the economic basis of schooling by drawing upon the free or low-cost resources and services to replace textbooks and other costly instructional materials, software, and other programs. Those funds could then be used for additional staffing, local curriculum development, technology staff, and ongoing local staff development, and the like.[11]

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[9]Multimedia uses a single communication system (cable) to transmit voice, data, and video, currently by digitizing voice and video.

[10]See, for example, The National Information Infrastructure: Requirements for Education and Training, National Coordinating Committee on Technology in Education and Training, (Alexandria, Va: 1994).

[11]Beau Fly Jones et al. Learning, Technology and Policy for Educational Reform, July 1994, Version 1.0., North Central Regional Educational Laboratory (Oak Brook, Ill.: 1994).

DATA SYSTEMS

Basic data systems include computers, some with CD-ROM
capability, connected to printers. A baseline data system enables
instructional computers to communicate with similar devices within
the classroom or the school (local area networks). Optimally, a
data system also includes computer networks compatible with outside
resources (wide area networks) such as the Internet;[12] computers in
the central office, in other schools, home computers; and databases
from the Department of Education or Library of Congress.

VOICE SYSTEMS

Voice systems include accessible two-way voice communication and
messaging (telephones) systems for staff members to communicate
with each other in the building and with the school community. A
baseline system includes a public address system, some outgoing
lines and telephones serving school offices and staff members, and
incoming lines to meet community and administrative needs.
Optimally, it also includes more outgoing and incoming lines and
sufficient capacity to allow for such developing technologies as
voice processing and voice mail.

VIDEO SYSTEMS

Video systems provide accessibility to television communication
and all forms of video transmission from locations within the
school building as well as from the outside. A baseline system
includes capability to receive instructional and teacher
professional programming as well as commercial and public
television stations, whether through a master antenna or via cable,
microwave, or satellite. An optimal system with today's technology
also includes capability in classrooms and teachers' offices to
dial up video sources in the school media center and to conduct
two-way video-interactive classes between classrooms, inside the
school, and between schools.

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[12]The Internet, a global communications network, is a cooperative
effort among educational institutions, government agencies, and
various commercial and nonprofit organizations. Historically, the
Internet has contained mostly scientific research and education
information. However, more recently, the kind of information
accessible on the Internet has expanded to include library
catalogs, full texts of electronic books and journals, government
information, campuswide information systems, picture archives, and
business data and resources. The Internet allows three primary
functions: electronic mail and discussion groups (e mail), use of
remote computers (telnet), and transferring files (ftp--file
transfer protocol).

APPENDIX II--RELEVANT SURVEY ITEMS WITH OVERALL PERCENT RESPONSE

17. Do this school's *on-site* buildings have sufficient capability in each of the communications technology elements listed below to meet the functional requirements of modern educational technology? *Circle one for EACH element listed.*

	Percent of Schools			
Technology Elements	Very Sufficient	Moderately Sufficient	Somewhat Sufficient	Not Sufficient
Computers for instructional use (N=77,400)	11.1	30.6	33.1	25.2
Computer printers for instructional use (N=77,412)	9.7	27.9	33.1	29.3
Computer networks for instructional use (N=77,350)	8.8	18.3	21.2	51.8
Modems (N=76,951)	4.9	14.0	23.6	57.5
Telephone lines for modems (N=76,986)	6.9	13.7	23.9	55.5
Telephones in instructional areas (N=76,827)	7.5	12.6	18.8	61.2
Television sets (N=77,211)	19.8	33.7	30.7	15.9
Laser disk players/VCRs (N=76,819)	7.7	25.4	33.5	33.5
Cable television (N=76,459)	20.1	25.9	22.3	31.7
Conduits/raceways for computer/computer network cables (N=76,987)	7.4	11.9	20.1	60.6
Fiber optic cable (N=76,015)	3.5	4.3	5.5	86.8
Electrical wiring for computers/communications technology (N=77,437)	7.8	17.7	28.4	46.1
Electrical power for computers/communications technology ·(N=77,414)	12.4	24.3	28.7	34.6

18. How many computers for instructional use does this school have? *Include computers at both on-site buildings and off-site instructional facilities.*

_____ computers for instructional use
{Range 0-1800
{Mean 50.7
{Median 37.0

19. How well do this school's *on-site* buildings meet the functional requirements of the activities listed below? *Circle one for EACH activity listed.*

	Percent of Schools			
Activity	Very Well	Moderately Well	Somewhat Well	Not Well At All
Small group instruction (N=77,606)	32.4	37.5	20.7	9.5
Large group (50 or more students) instruction (N=77,178)	10.7	24.4	26.7	38.2

Technology Elements	Percent of Schools			
	Very Sufficient	Moderately Sufficient	Somewhat Sufficient	Not Sufficient
Storage of alternative student assessment materials (N=77,058)	7.8	24.2	36.7	31.3
Display of alternative student assessment materials (N=76,797)	7.9	26.6	37.9	27.6
Parent support activities, such as tutoring, planning, making materials, etc. (N=77,496)	12.3	29.7	34.5	23.5
Social/Health Care Services (N=77,456)	10.8	30.1	32.1	27.0
Teachers' planning (N=77,397)	20.6	37.4	28.9	13.1
Private areas for student counseling and testing (N=77,530)	14.6	28.4	31.3	25.7
Laboratory science (N=76,344)	11.2	21.4	25.4	42.0
Library/Media Center (N=77,701)	24.9	35.3	26.5	13.4
Day care (N=72,083)	4.3	7.9	10.3	77.5
Before/after school care (N=73,335)	6.8	15.3	19.2	58.8

DATA TECHNOLOGY ELEMENTS

Table III.1: Majority of States Report That at Least 50 Percent of Schools Have Six or More Insufficient Technology Elements

Percent of schools with six or more insufficient technology factors	States
20-29	Nevada, South Dakota
30-39	Arkansas, Iowa, Kentucky, Minnesota, North Dakota, Pennsylvania, Texas, Wyoming
40-49	Arizona, Colorado, Georgia, Indiana, Kansas, Mississippi, Montana, Nebraska, New Jersey, West Virginia, Wisconsin
50-59	Alaska, Connecticut, District of Columbia, Florida, Louisiana, Maryland, Missouri, New York, Oklahoma, South Carolina, Tennessee, Utah, Vermont, Virginia
60-69	Alabama, California, Idaho, Illinois, Massachusetts, Maine, Michigan, North Carolina, New Hampshire, Oregon, Rhode Island, Washington
70-79	Delaware, Hawaii, New Mexico, Ohio

Note: Sampling errors range ± 7.1-13.5 percent.

Table III.2: Percent of Schools Reporting Insufficient Technology Elements—Data, Voice, Systems Infrastructure—by State

State	Computers	Printers	Networks	Modems	Phone lines for modems	Phone lines instructional area
Alabama	32.1	36.3	58.8	61.7	58.4	64.1
Alaska	36.5	36.2	56.4	58.8	53.8	60.9
Arizona	15.8	18.3	48.4	60.8	58.1	61.8
Arkansas	8.5	17.5	36.7	63.7	58.4	58.3
California	37.1	38.7	68.8	70.5	68.1	64.8
Colorado	20.9*	23.9*	37.0*	61.8	56.8	45.3
Connecticut	28.5*	28.9*	63.9*	58.4*	51.9*	52.7*
Delaware	44.5*	52.7*	68.7*	63.0*	82.9*	82.4*
District of Columbia	22.0*	31.4*	37.:	48.9*	52.7*	52.8*
Florida	28.8	28.8	68.4	68.0	63.2	62.3
Georgia	11.8	13.7	33.9	48.0	53.0	71.7
Hawaii	38.0	44.7*	72.0	78.7	78.5	74.7
Idaho	25.3	31.8	56.9	63.8	58.8	72.1
Illinois	30.2	39.0	57.7	68.7	63.4	64.2

Table III.2: Percent of Schools Reporting Insufficient Technology Elements—Data, Voice, Systems Infrastructure—by State

State	Computers	Printers	Networks	Modems	Phone lines for modems	Phone lines instructional area
Indiana	16.5	18.3	42.1	50.7	55.0	58 2
Iowa	15.3	16.5	43.5	48.5	43.8	55.4
Kansas	22.8	27.7	44.0	47 3	44.4	61.7
Kentucky	13.1	19.8	35.5	57 2	55.7	67 2
Louisiana	31 8	38 6	62.5	59 5	65 5	78 7
Maine	31 0[a]	31 8[a]	62.9[a]	69.6[a]	63 6[a]	69 4[a]
Maryland	29 1	30 4	44 1	62.3	66 7	87 0
Massachusetts	32 5[a]	43 1[a]	70.4	71 1	66.9	71 9
Michigan	36 9	38 8	63.3	64 1	58 1	63 4
Minnesota	22.5	21 7	41 5	42 7	41 0	41 4
Mississippi	16 9	20 3	37 6	53 8	55.8	62 7
Missouri	23 3	32.8	52.4	60 5	59 1	65 4
Montana	17 1	19 0	47 5	46 8	37 5	53.2
Nebraska	11 2	10.1	43.3[a]	55.5[a]	45 7[a]	44 4[a]
Nevada	14 4	15 9	26.9	26.2	26 2	27 1
New Hampshire	44 0[a]	42 9[a]	65.6[a]	68.4	58.6[a]	66.4[a]
New Jersey	20 0	24.5	41 8[a]	36.1[a]	33.5	62.9
New Mexico	36 3	44 9	69.6	79.0	58 5	57 3
New York	20.2	24 2	44 0	48.9	55 3	57 9
North Carolina	30.1	33.3	51.1	62.2	62.6	73 6
North Dakota	17 3	19.8	36.7	40.2	36.5	48.9
Ohio	38.2	50.7	71.8	74 0	70.5	76 2
Oklahoma	22.9	33.0	50 8	63.4	57 7	60.0
Oregon	38.2	41 8	66.2	59.8	65.1	65 6
Pennsylvania	18 2	19.4	50.2[a]	54.7[a]	44.2[a]	48.7[a]
Rhode Island	37.1[a]	42.7[a]	49.3[a]	67 3[a]	52.1[a]	67 3
South Carolina	33 0	35.1	56.1	55.2	50.3	61 5
South Dakota	9.8	9 9	37 0	37 0	35.4	42.0
Tennessee	20 4	22.8	48.0	62.7	65.6	68 6
Texas	12.8	15.6	31.3	36 9	38.4	44 0
Utah	6.9	7.9	28.7	54.4	71 0	77 5
Vermont	32.7[a]	31.7[a]	65.7[a]	55.9[a]	61.4[b]	56 1[a]
Virginia	31 3	37.7	56.5	54.1	52.9	56.0
Washington	32.0	39.8	60.5	61.8	61.1	66.3
West Virginia	16.5	17 2	32.3	56.8	51.5	71 6
Wisconsin	22.4	24.5	44.6	45.4	46.4	58 9
Wyoming	9.8	13.2	32.7	41.4[a]	33.8	44 5

Note: Sampling errors are less than ± 11 percent unless otherwise noted. Responses marked with a superscript "a" have sampling errors equal to or greater than 11 percent but less than 13 percent. Responses marked with a superscript "b" have sampling errors equal to or greater than 13 percent but less than 18 percent. Sampling errors may be high for state tables because they are not adjusted for finite population correction.

Table III. 3: Percent of Schools Reporting Insufficient Technology Elements—Video and Building Infrastructure—by State

State	Television	Laser disk player/VCR	Cable TV	Conduits	Cable	Wiring	Power
Alabama	15 0	34 6	33 3	61 9	74 6	44 1	33 9
Alaska	35 3	46 3	55.6	67 4	90 9	52 1	44 7
Arizona	16 8	23.1	30 4	56 0	83 5	36.3	27 8
Arkansas	6 6	21.6	12 6	43 1	65.1	34 1	19 8
California	21 0	41 2	49.9	79 7	92.8	69 1	55 8
Colorado	16 9	29 7[a]	28 8	49 7[a]	88.2	38.5[a]	32 7[a]
Connecticut	25 1	35.0[a]	42 4[a]	62.9[a]	91 3	55 1[a]	41 2[a]
Delaware	32.8[a]	60.9[a]	45 4[a]	76 9[a]	93.3	69.5[b]	48 8[a]
District of Columbia	21 6[a]	31 4[a]	25 8[a]	50.0[a]	58 0[a]	45.8[a]	41 4[a]
Florida	8 6	28.9	19.7	67 6	88 0	64.3	41 9
Georgia	14 8	28.8	12 8	57 8	87.1	44.0	36.3
Hawaii	4 7	29.8	18 8	62.1	66 7	75 1	61 4
Idaho	23.0	44 5	42.7	72.3	91 0	51 2	36 8
Illinois	23 3	43.7	43.4	68 8	87 0	52.6	41 1
Indiana	12 9	24.0	27.1	52.3	82.8	43 1	32 0
Iowa	4 5	21.0	13.2	48 8	84 8	31 3	15.4
Kansas	17 8	34.8	31 2	57.3	89.0	40.7	13 6

State	Television	Laser disk player/VCR	Cable TV	Conduits	Cable	Wiring	Power
Kentucky	3.2	23.2	8.0	49.8	75.2	35.8	25.1
Louisiana	18.4	40.4	42.7	61.8	87.7	47.2	38.8
Maine	19.7	43.7ᵃ	46.2ᵃ	72.8	94.0	46.7ᵃ	35.0ᵃ
Maryland	36.2	52.1	38.5	81.9	91.8	46.8	36.0
Massachusetts	34.9ᵃ	48.0ᵃ	44.2ᵃ	73.9	88.1	60.8	49.4ᵃ
Michigan	27.1	42.1	27.1	68.7	85.6	51.0	38.3
Minnesota	17.3	31.8	27.4	48.9	72.3	7.4	25.2
Mississippi	4.8	36.7	32.5	55.8	85.0	26.6	19.9
Missouri	8.8	26.0	17.3	53.2	87.9	33.7	26.0
Montana	14.8	25.4	42.0	62.1	81.7	38.8	24.9
Nebraska	1.7	12.5	31.0ᵃ	62.4	83.3	33.1	21.2
Nevada	4.1	13.9	14.8	43.6	78.2	26.4	25.1
New Hampshire	27.4ᵃ	43.7ᵃ	26.8ᵃ	69.4	68.8	57.7ᵃ	35.9ᵃ
New Jersey	11.2	24.9	32.5	55.2ᵃ	85.8	41.2ᵃ	34.2
New Mexico	15.4	54.8	51.8	77.3	87.1	48.5	42.1
New York	24.7	38.1	35.9	55.5	82.3	50.7	34.7
North Carolina	15.2	30.9	24.5	66.0	92.3	55.4	41.8
North Dakota	15.1	30.9	27.5	56.0	69.5	33.8	17.7
Ohio	16.0	44.1	31.3	78.8	95.0	63.0	50.8
Oklahoma	18.8	35.2	32.8	54.6	81.7	41.4	32.3
Oregon	20.9	35.8	23.3	68.0	87.8	56.0	33.7
Pennsylvania	13.3	34.7ᵃ	27.4	41.0ᵃ	86.8	32.2	17.4
Rhode Island	27.4	41.0ᵃ	17.3	74.0	90.8	64.2ᵃ	45.0ᵃ
South Carolina	5.6	25.3	29.8	62.9	87.1	41.1	33.2
South Dakota	7.8	22.4	13.6	43.3	69.7	22.9	14.6
Tennessee	6.9	37.1	27.1	56.0	94.3	38.8	25.4
Texas	8.7	17.0	31.6	46.0	83.0	28.6	22.3
Utah	4.8	22.1	39.4	55.3	93.3	38.8	26.7
Vermont	10.0	38.1ᵇ	57.8ᵃ	66.3ᵃ	95.8	46.5ᵇ	26.2ᵃ
Virginia	4.1	36.7	18.4	57.5	93.5	38.1	29.5
Washington	15.0	41.2	34.9	81.0	86.3	47.0	35.1
West Virginia	4.2	30.8	14.4	48.8	93.2	36.2	18.0
Wisconsin	11.3	24.2	20.5	52.5	86.3	38.5	33.4
Wyoming	11.8	21.2	40.1ᵇ	50.9ᵇ	83.8	29.6	15.9

Note: Sampling errors are less than ± 11 percent unless otherwise noted. Responses marked with a superscript "a" have sampling errors equal to or greater than 11 percent but less than 13 percent. Responses marked with a superscript "b" have sampling errors equal to or greater than 13 percent but less than 18 percent. Sampling errors may be high for state tables because they are not adjusted for finite population correction.

Table III.4: Percent of Schools Reporting Insufficient Technology Elements by Community Type

Technology element	Central city	Urban fringe/ large town	Rural/ small town
Fiber optic cable	90.2	87.8	84.4
Conduits	66.6	61.8	56.8
Phone lines in instructional areas	66.8	60.8	57.8
Modems	66.0	55.8	53.5
Networks	60.9	50.6	46.5
Phone lines for modems	61.3	56.3	61.8
Electrical wiring for communications technology	54.8	46.7	40.1
Electric power for communications technology	42.9	38.9	27.8
Laser disk player/VCRs	38.7	32.2	30.9
Printers	38.1	28.7	28.2
Cable TV	33.0	32.8	30.0
Computers	31.7	24.8	21.2
TVs	18.8	17.1	13.3
Six or more unsatisfactory technology elements	60.0	52.0	46.8

Note: Sampling errors range ± 1.7-3.8 percent.

Table III.5: Percent of Schools Reporting Insufficient Technology Elements by Level of School

Technology element	Elementary	Secondary	Combined
Fiber optic cable	88.3	82.9	84.7
Conduits	63.3	53.1	60.6
Phone lines in instructional areas	64.4	53.2	52.8
Modems	60.9	48.4	54.1
Networks	54.6	42.9	53.6
Phone lines for modems	58.4	47.6	52.3
Electrical wiring for communications technology	48.7	39.2	42.9
Electric power for communications technology	36.7	29.1	30.5
Laser disk player/VCRs	34.9	30.1	29.7
Printers	31.7	23.2	25.9
Cable TV	33.7	24.3	42.7
Computers	27.0	20.3	22.2
TVs	17.3	11.9	14.8
Six or more unsatisfactory technology elements	55.7	41.5	50.9

Note: Sampling errors range ± 1.4-4.0 percent.

Table III.6: Percent of Schools Reporting Insufficient Technology Elements by Proportion of Minority Students

Technology element	Percent of minority students in schools			
	Less than 5.5	5.5 to 20.4	20.5 to 50.4	More than 50.5
Fiber optic cable	85.6	86.2	88.2	88.3
Conduits	59.3	56.2	65.5	62.9
Phone lines in instructional areas	60.7	59.4	60.6	64.9
Modems	55.9	52.7	59.9	63.1
Networks	48.9	49.6	56.2	55.0
Phone lines for modems	54.0	51.2	58.7	59.9
Electrical wiring for communications technology	42.3	44.7	48.9	53.5
Electric power for communications technology	30.3	30.5	36.3	44.6
Laser disk player/VCRs	31.3	29.1	37.6	38.4
Printers	27.1	26.5	30.3	33.4
Cable TV	28.2	25.7	33.9	41.4
Computers	23.5	24.9	25.6	26.0
TVs	13.1	15.4	14.7	22.3
Six or more unsatisfactory technology elements	48.7	50.0	54.4	57.4

Note: Sampling errors range ± 1.8-4.0 percent.

Table III.7: Percent of Schools Reporting Insufficient Technology Elements by Geographic Region

Technology element	Northeast	Midwest	South	West
Fiber optic cable	86.5	85.7	86.1	89.4
Conduits	57.2	61.5	56.0	69.0
Phone lines in instructional areas	59.2	60.9	62.0	61.9
Modems	53.9	57.8	54.9	63.9
Networks	52.0	53.3	45.6	59.0
Phone lines for modems	51.0	55.1	54.2	61.6
Electrical wiring for communications technology	47.2	44.9	40.9	55.0
Electric power for communications technology	33.5	34.0	30.4	42.6
Laser disk player/VCRs	36.7	33.5	29.7	36.7
Printers	27.6	31.4	25.6	33.6
Cable TV	35.4	26.3	26.4	41.3
Computers	23.7	26.2	21.7	30.1
TVs	21.0	15.7	11.3	18.9
Six or more unsatisfactory technology elements	50.8	52.3	47.1	59.9

Note: Sampling errors range ± 1.6-4.5 percent.

Table III.9: Percent of Schools
Reporting Insufficient Technology
Elements by Proportion of students
Approved for Free or Reduced Lunch

Technology element	Percent of students approved for free or reduced lunch			
	Less than 20	20 to less than 40	40 to less than 70	70 or more
Fiber optic cable	86.9	86.3	87 9	88 9
Conduits	59.2	60.4	64.1	62 2
Phone lines in instructional areas	57.9	59 9	64 3	68 2
Modems	52.1	56.1	62 4	61 9
Networks	48.0	50 1	56 3	54.3
Phone lines for modems	51.7	56 2	57 4	59 5
Electrical wiring for communications technology	45.7	43.5	46.7	47.8
Electric power for communications technology	32.2	32.0	35.5	38.1
Laser disk player/VCRs	30.3	30.6	37.8	38.1
Printers	23.7	26.4	33.3	30.0
Cable TV	25.5	26.6	31 8	37.8
Computers	20.9	23.7	26.0	25 4
TVs	14.5	12 4	16.2	17 3
Six or more unsatisfactory technology elements	47.7	49.6	56 0	56.1

Note: Sampling errors range ± 1.7-3.9 percent.

Table III. 9: Average Number of Students per Computer by State

State	Students per computer		State	Students per computer
Alabama	16.8		Montana	7.9
Alaska	7.6		Nebraska	10.3
Arizona	11 9		Nevada	21.4
Arkansas	12.5		New Hampshire	20.6
California	21 1		New Jersey	13 5
Colorado	12.6		New Mexico	10.8
Connecticut	14.5		New York	15.8
Delaware	17.7		North Carolina	13.4
District of Columbia	17 2		North Dakota	8.7
Florida	12.1		Ohio	25.3
Georgia	13.8		Oklahoma	13.2
Hawaii	15.6		Oregon	15.5
Idaho	12.7		Pennsylvania	14.8
Illinois	16 9		Rhode Island	21.6
Indiana	11.1		South Carolina	12 4
Iowa	10 9		South Dakota	9 0
Kansas	9 9		Tennessee	16.7
Kentucky	10 2		Texas	11.4
Louisiana	20 6		Utah	11 7
Maine	16 9		Vermont	16.9
Maryland	14 9		Virginia	12.7
Massachusetts	15 6		Washington	13.7
Michigan	19.9		West Virginia	12.9
Minnesota	10.2		Wisconsin	10.7
Mississippi	14 5		Wyoming	7 0
Missouri	15 2			

Note: Sample errors range ± 1.1-4.9 percent, except Vermont, which was 8 percent.

RATIO DOWN

Senator COCHRAN. I am going to recognize Senator Jeffords for any question that he might have first.

Senator JEFFORDS. Thank you, Mr. Chairman. This has been probably the most exciting hearing I have been to while I have been in Congress.

I think it is just fantastic that you have gathered these witnesses to let us know that there is hope to get our educational problems under control.

I appreciate you recognizing me early. I have a date every Tuesday at noon at Grant School with my third grader to read, and so I will be leaving shortly to go over and meet him. But I have a chance to get around a lot of schools, being chairman of the Education Committee in the Senate.

You mentioned, Dr. Hayes, that the average is down to 12 per student. That shocks me, because in my visits I have not seen many schools with that kind of a ratio. Does that mean 1 hour per day, or what does that mean?

Dr. HAYES. It is not quite time access. It is simply taking the physical number of instructional computers in the school, and dividing it into the number of students.

But it sounds to me as if you are going to a third grade classroom, you are looking at elementary schools, where the ratios are really typically worse. Our secondary schools have been the place for the early adoption of computers, and the continuing better ratios exist.

So if you are finding 20 students per computer in elementary school, I would not be surprised.

Senator JEFFORDS. Yes.

Ms. FULTON. Senator, we did try to look at just not the numbers of computers, but the way they are being used, and how much they are being used, and we had a survey of computer coordinators who suggested that students use technology 2 hours a week as a total in all of their subjects, but then there was another interview at the same area, and the students said it was about one-half that much.

So the numbers do not tell the story. The story is, in fact, how much teaching is going on with them.

Senator JEFFORDS. Yes.

Dr. KELLY. There is also data to show that when schools early adopt computers, they typically adopt them in a lab configuration, which constricts the amount of time that students have access, and who has access.

And as they move on to technology awareness, then they move the computers from a lab configuration into a classroom and a teaching configuration.

So what you may observe is, you go into a school in which there is no computer in the classroom, that, in fact, all the computers are located in labs, to a variety of mixes of those, between labs and in class.

Senator JEFFORDS. Well, I have seen the worst and the best. I tell you, I was at one school in New York City in a six-story building, and they had about half a dozen computers on one floor, and they had 1970's software.

It was a sad thing. But that teacher was in love with it, and she had gone out and bought some software with her own money. We have incredible needs in some of these places.

We have other means of communication techniques now, such as new direct linkage from 16-inch dishes.

Is it not risky to gamble that telephones are going to be the primary means for technological advances? Is that a gamble we should make, and try to fund, or are there other technologies which are soon going to be available and cheaper?

Ms. FULTON. I do not think there is any one answer. Much of what depends is what is in place in a community. Some places have very strong cable systems. Other places have fiber optic laid.

There are some interesting examples of trying wireless technologies for some of the connections. But in each of these, even in the wireless, they tend to use them for more local application, and the access to a broader link may still require the computers and telecommunications links.

So there is no one answer. I do not think anybody is putting all their chits in one place.

Senator JEFFORDS. What needs to be done to get our teachers up to speed? What does it take?

Dr. HAYES. Well, one thing is to give them a computer or to provide them access. Our studies show that fewer than 30 percent of teachers in the United States actually have exclusive use of a computer at school, as I believe Kathleen alluded to earlier, as did several others, that means that they have a less technology-driven environment at school than they do at home. So I would suggest getting teachers a computer as a foundation to that process.

Dr. KELLY. There have been some very effective models on looking at what is the best, quickest way to have a teacher to be able to use computers in a teaching, learning environment.

One of the successful ones has been to provide a teacher with some inservice, perhaps as much as 40 hours of inservice, and then send the computer home for the summer, and make it part of the teacher's regular environment, in terms of being at home.

And then when the teacher comes back from the summer vacation, it is very interesting to see what kind of gains have been made in terms of infusing the use of technology into their work environment as a tool for themselves, so they can graduate and use it as a learning tool for their students.

But you have to keep in mind, how much time does a teacher have in the classroom itself. I mean does a teacher sit down at their desk? Do you want a teacher sitting down at their desk all day using a computer? I do not think so.

I think you want the teacher interacting with the students, and you want the teacher using the technology as a teaching tool, but first they have to become computer users themselves on a personal basis.

Senator JEFFORDS. Well, I want teachers not to be afraid of computers. I recognize they will not all be experts, but at least, my feeling is, from visiting school districts, the problems teachers have, as well as the rest of us are relatively simple. However, as you have seen, even the members here grapple with these problems.

Senator COCHRAN. Well, wait a minute. Some of us were not grappling. [Laughter.]

Senator JEFFORDS. But that is a serious problem. I have to leave, but I just want to thank you again. I have so many questions. This is so incredibly important for us to get up to speed as fast as we can, but I can see the cost involved.

And the GAO, I know you just came out with a study recently on school buildings for Senator Moseley-Braun. Did that include in it, do you know, the needs for technology separately, and a way to measure the needs for telecommunications infrastructure?

Ms. MORRA. We have a lot of information, not only nationally, but for each State. For example, we came out with a similar ratio of kids per computer of 11 to 1, but it really varies by State. So, for example——

Senator JEFFORDS. Well, again, is that a certain grade level, or is that from 6 to 12?

Ms. MORRA. The numbers that I am reporting now would be K through 12, but some of them we can break up by elementary and secondary. And certainly, computers are more prevalent at the secondary levels than at the elementary school levels.

But we see a range, overall, in K through 12, for example, of some States that have a ratio of 7 kids to 1, but other States that have a ratio of 21 kids to 1. So things really vary.

But one of the biggest points that I think comes out of our study is the inadequate, insufficient electrical wiring. What we even saw, when we went around to some of these places, for example, one school in Chicago, they had a lot of computers sitting there that they probably added into their ratio, so they may have looked like they had a good student-computer ratio, but all the computers were sitting in piles and boxes in this room, because they did not have the electrical wiring to plug them in.

We heard of other schools, for example, where the teachers said, well, you know, I would like to use the computer, but our classrooms only have two outlets each, and if four of us use the two outlets at the same time, we trip the circuit breaker.

It happens once a month, as is. This problem of schools only being wired for film projector, is a very serious, very real problem.

Senator JEFFORDS. My last question is: Taking into consideration the amount of capital that will be necessary to try and increase these ratios, what happens to all the upgraded computers?

We just upgraded all of ours in Congress here. Is there any way that anybody tries to see how we can get those to schools, if they are still useable? There must be millions of older computers floating around.

Ms. MORRA. We saw in our trips a lot of donated computers, which was good, but the one thing that—it does not allow any kind of networking, and it created problems in that all these different computers require different kinds of software. You could not do a large group and have students all using the same software. You could not have students talking to students, because these were all different kinds of packages, different types of equipment.

And that really is a problem when they get this hodge-podge of equipment in the classroom.

Ms. FULTON. I was just going to say, one of the donations that we have seen is very often when high schools upgrade, then they send their older computers down to the elementary schools, so there are lots of different ways these things are happening.

But teachers are usually so eager to get whatever they can get, that even with these problems, at least the ones who are comfortable with the technology, will say, well, I will figure out something, and I can use this for some activities, if not for everything. So some of those programs at least are putting more into the schools.

Dr. KELLY. One of the things you have to keep in mind, though, is when you talk about teaching and learning, there are some fabulous things that are coming out on the market that have either been spurred by Federal Government funds, or State funds, or whatever, they require high memory, they require speed.

Teachers see those things, they get excited about the things that students can do with those things, then they turn around, they go back to their classroom, and they have an old Apple II-E, with some old software, and they get very, very frustrated.

They get very frustrated at being perceived as second-class citizens, always with the castoffs. So if we are going to try and get people, or continue to get people enthusiastic about it, we are going to have to put our priorities where they belong.

Senator JEFFORDS. Thank you very much, Mr. Chairman.

Senator COCHRAN. Thank you, Senator Jeffords, for your attendance and participation at the hearing. You have made an excellent contribution, and for that we are very grateful. You are also Chairman of the Education Subcommittee again this Congress, and we know you have a lot of influence in these matters.

Let me ask another question. You were talking about students having access to computers, and the availability of computers in the classroom, and teacher training, and the like.

It occurs to me that we have gotten to the point where we ought to consider requiring teachers, before they can be certified as teachers, to be computer literate. I do not know why we do not do that. Does anybody have a reaction to that?

Ms. FULTON. There are a number of States who required that. We have a list in our report that shows that, and it has increased somewhat, but not that much even since our 1988 study.

I think there are 18 States that require that of teachers, and before it was something like 12 States. But, again, how you define computer literate keeps changing as well. But there are lots of ways that States can encourage this in the way they set up their requirements for new teachers.

Dr. KELLY. I am one who teaches one of those classes——

Senator COCHRAN. Of teachers to use computers.

Dr. KELLY [continuing]. Of teachers—yes; it is called a clear credential requirement in the State of California, to take an educational technology course.

Now, the legislation does not say course. The legislation gives a set of competencies that teachers must have in order to be able to have a certain certificate. But the difficulty we have found in California is twofold.

Either the university itself does not put educational technology to the forefront, so the kind of technology that the teachers are coming out with is behind what the schools have, or it is the reverse, the university has put resources into it, those preservice, becoming teachers are very well aware, they go out into a classroom very enthusiastic, and they have nothing to work with.

Senator COCHRAN. Well, we all use our own experiences, like your story about your daughter and the computer experience she had. I think about when I went on the board at the Air Force Academy, one of the things that impressed me was that each entering new student at the Air Force Academy is issued a computer.

Standard with the uniform and everything, you got a computer. It is in your room, and it is your computer, and you use it for the 4 years you are there, so when you come out of that experience, it is just part of your education. You are competent in using it, obviously comfortable in it.

I wish that it were such that all of our colleges and universities had the same kind of opportunity to give all their students.

Dr. Miller pointed out that Kodak is not in the business, and most companies are not, of providing remedial education for employees. You expect that people come to the job with a certain level of competence, education, and abilities.

I think we are going to have to start expecting that of teachers, too. They should come to the job of teaching with a level of competence and familiarity with technology, and computers, especially. The should not have to be taught after they get there how to use them, but should know before they get there how to use them.

What is your reaction to that, Dr. Miller?

Dr. MILLER. Well, I agree, absolutely, but I cannot stress enough, also, the need for constant retraining, too. As was pointed out earlier, the teacher training that is going on now in the few States that do have requirements—and I actually taught at the University of Missouri 10 years ago, and was one of those people teaching teachers how to use computers.

Those people who came through my program 10 years ago, I hope have had some retraining. [Laughter.]

But we certainly expect it in the business world, and I would assume that the world of education is no different.

Senator COCHRAN. Well, I cannot thank you enough for the contribution you have all made to this hearing. We have had, I think, an excellent hearing.

Senator Jeffords' comment about it was the most exciting and interesting hearing he has had an opportunity to attend since he has been in Congress mirrors my view, too. This has been an excellent hearing.

First of all, I want to thank Doris Dixon, who is my staff member whose inspiration was the cause of our having the hearing, and then organizing it, and inviting the witnesses, arranging it. Thanks also to the other members of our subcommittee staff, Bettilou Taylor, Richard Wing, and Meg Snyder, who have all contributed so much to the success of the hearing.

Again, I want to thank PBS for setting up all of the equipment that we used today, and having staff members available here to help us understand how to use the laptops that we put on the

desks instead of in our laps, and all of the other equipment that we had the opportunity to use today, all worked together to make this an excellent hearing.

To all the witnesses who came from far and near, thank you very, very much for doing that.

I think the hearing record that we made today is going to serve a very important purpose to help us make decisions that are based on reality, the facts and the needs. In view of the budget constraints, the quality of our decisionmaking now is more important then ever, about what we fund, and at what level we fund it at the Federal level.

It is going to have very important consequences, in terms of the quality of our education system throughout our country. It is quite a sobering challenge that we face, and your being here has helped us do a better job of that. For that, we are very grateful to all of you.

CONCLUSION OF HEARING

The subcommittee will stand in recess subject to the call of the Chair.

[Whereupon, at 12:15 p.m., Tuesday, April 4, the hearing was concluded, and the subcommittee was recessed, to reconvene subject to the call of the Chair.]

Material Submitted Subsequent to Conclusion of Hearing

[CLERK'S NOTE.—Additional material was received by the subcommittee subsequent to the conclusion of the hearing. The statement will be inserted in the record at this point.]

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STATEMENT OF JOHN CRADLER

One of the most important issues facing Congress is to work with business, education, and the states to enable the nation's schools to better prepare students for a technological workforce and to ensure that education has a place on the National Information Infrastructure. This document provides background and important information for national leaders concerned about education, the information infrastructure, and related issues for the Federal Government.

1. Why are technology and telecommunications important for education?
A review of current research and evaluation findings from studies (1993) has determined that the integration of technology and telecommunications into education...

* Improves attitude and confidence–especially for 'at-risk' students.
* Provides instructional opportunities otherwise not available.
* Increases and expands learning opportunities.
* Increases mastery of vocational and work force skills.
* Significantly improves student problem-solving skills.
* Improves writing skills as a result of using telecommunications.

Another review of technology and reform conducted by the Council for Educational Development and Research (1995) concludes that for technology to be effectively applied in schools...

* Schools should not support a technology design that does not empower learning.
* Schools must connect technology to powerful learning designs.
* Schools must, from the outset, plan on connecting their technologies to the NII.

Other studies show that the Federal government has already played a significant role in supporting and leveraging effective uses of technology in education. The Office of Educational Research and Improvement (OERI) has funded many studies and developmental projects and programs that have and continue to help states implement and procure local funding for technology in education. Far West Laboratory (FWL) and the South West Laboratory for Educational Research completed major OERI studies on distance learning. These studies showed that distance learning generally is a very cost-effective strategy for bringing, previously unavailable, quality instruction to rural areas of the country. The studies provided ongoing feedback to the developers of the programming to ensure alignment with high academic standards, interesting programming to meet needs of diverse learner populations, and provided information needed to inform states about ways to adopt, adapt, and provide local funding to sustain these resources.

The Regional Educational Laboratories in collaboration with the federal and state governmental agencies and business and industry are expanding efforts to conduct applied research and evaluation needed to support high quality local applications of technology in education. The Improving Americas Schools Act (IASA) provides needed incentives and guidelines to promote the expansion of research and evaluation needed to keep education and policy makers informed about the present and rapidly emerging benefits of technology to enhance teaching and learning in the United States.

3. Do information technologies contribute to needed education reform?

We know that technology is rapidly emerging as a critical component of education. Research has consistently shown the benefits of distance learning and telecommunications. For example, Far West Laboratory for Educational Research and Development, in San Francisco, studied the impact of Educational Technologies from 1984 to 1991, has conducted extensive research on the California Model Technology School Projects, and has recently completed studies of the TEAMS Star Schools Program and the Hughes Galaxy Classroom Distance Learning Program. Currently FWL is conducting a comprehensive state by state analysis of state educational technology plans and legislation. Findings are as follows:

Technology alone does not have a significant effect on teaching and learning. . . it is a tool that when used with tested and instructional practices and curriculum can be an effective ingredient to foster change. Examples of the many findings from federally funded studies show that for technology applications are effective when

* teachers integrate technology into curriculum and instruction
* technology offers opportunities for students to solve problems and construct solutions.
* teachers and administrators jointly plan for the use of technology.
* government promotes applications of technology and development of software and video programs that meet educational content standards.

- policy leaders and administrators at all levels of government and business work together to promote the planned use of technology to support teaching and learning

2. To what extent is telecommunications access a priority for education?

The NCC-TET, representing a consensus of over 85 national professional education, business, and trade associations, developed 19 requirements for education and the National Information Infrastructure (1994), which are summarized as follows:

Access Requirements

- Ensure that all learners have affordable and equitable access to the NII.
- Ensure that the NII is accessible in a variety of learning environments.
- Develop a variety of sustained public and private partnerships and funding.
- Make public and private information resources available.

Application Requirements

- Coordinate NII-related education activities conducted by Federal departments and agencies.
- Develop and disseminate NII guidelines for education.
- Identify and disseminate effective education and training applications.
- Integrate applications of the NII into education reform.
- Develop quality education and training applications.
- Conduct research on the education applications.
- Promote professional development and technical assistance.
- Support on-going evaluation of the effectiveness and impact of the NII.

Technical Requirements

- Emphasize interactive, broadband transmission of interactive voice, video, and data.
- Provide seamless interconnection among networks.
- Guide the development of voluntary standards to promote interoperability.
- Ensure that the NII is easy to use.
- Develop "navigation" systems for locating resources on the NII.
- Support user collaboration.
- Create adequate security measures for network resources.

The Council of Chief State School Officers (CCSSO), under cooperative agreement with the National Telecommunications and Information Administration (NTIA) of the US. Department of Commerce just released a report on telecommunications and the National Education Goals through it's "USE IT" project. USE IT makes recommendations for the federal role in education and the NII drawn upon the expertise of key individuals from education, government, and private industry, as follows:

- Education agencies at all levels must support development and use of distance-learning to achieve the National Education Goals.
- The telecommunications industry, distance-learning service providers, and regulatory agencies must support and develop distance-learning delivery systems that are compatible and interoperable.
- Federal government should promote public/private partnerships for distance learning and support regional and statewide applications of distance learning as an integrated national resource.
- Federal regulatory agencies must develop policies that ensure affordable rates for the educational uses of telecommunications resources.
- Federal and state agencies, in cooperation with the private sector should develop new resources for investment and capital development for distance learning.
- National authorities should undertake awareness and outreach activities to inform educators, business and industry, and the public of the value and importance of distance learning to achieve the National Education Goals.

4. What is the current reality regarding access and use of technology in schools?

Recent surveys show that we are developing a nation of education 'haves' and 'have nots' with respect to educational access and use of the information highway.

The National Center for Education Statistics (1995) reports the following:

- Overall, 35 % of public schools have access to the Internet but only 3 % of all instructional rooms (classrooms, labs and media centers) in public schools are connected to the Internet.
- Funding is the major barrier most often cited in the acquisition or use of advanced telecommunications in public schools.
- Seventy-five percent of public schools have computers with some type of telecommunication capabilities (i.e., local area networks or wide area networks).
- Smaller schools with enrollments of less than 300 are less likely to be on the Internet than schools with larger enrollment sizes. Only 30% of small schools reported having Internet access, while 58% of schools with enrollments of 1,000 or more reported having Internet access.

An American Electronics Association (1995) survey concludes:

- The NII in schools would benefit curriculum content, increase computer skills for students, increase student motivation, provide greater opportunities for students for independent investigation and research, and increase access to information for educators.
- The NII would equalize opportunities for economically disadvantaged and disabled students.
- In order for the NII to be successfully implemented in schools, sufficient funds and equipment, adequate training of educators on the availability and use of information technologies, and inexpensive access to telecommunications is essential.

A recent report from the White House Office of Educational Technology and Policy (OSTP) reported that less that one percent of the amount expended for R & D in technology-related defense training is expended for similar purposes in education. This statistic is also commonly reported for business and industry in comparison to education. This suggests an important reason that schools are as FCC Chair Reed Hundt would say:

> *"there are thousands of buildings in this country with millions of people in them who have no telephones, no cable television and no reasonable prospect of broad band services. They're called schools."*

Many other leaders of this country are making similar observations about the nation's schools. The Speaker of the House, Newt Gingrich recently stated that all students should have access to the internet and that all persons should possess a laptop computer.

5. What can the federal government do to help ensure that teachers and learners can access and benefit from the information highway?

Their is little doubt that the federal government should play a strong and active role in regarding education and the NII. As this report documents, there has been much attention to this issue and in every case, findings generally suggest that the federal government should provide the policies to ensure education access along with necessary research and development to offer the models and guidance needed by states and localities for the successful design and application of technology in a variety of learning environments. To some extent the Federal role in supporting technology in education has already been defined and recently put in statute with the Goals 2000 and the Improving Americas Schools Act (IASA). This legislation established:

- National policy and planning leadership with the U.S. Office of Educational Technology
- National educational technology R & D partnerships between business and education through the recently announced "Challenge Grants"
- Regional staff development and assistance for effective technology integration
- Grants for the local, planned application of technology to support teaching and learning
- Distance learning programs, instructional video development, and others

The design of these programs was guided by extensive study and research with a great deal of public input from the states. In fact, much of the language was derived from state policies that have proven themselves over time. These programs incorporated in this legislation were authorized and funded for FY 1995. However, the proposed recissions may eliminate the opportunity for these programs to be implemented and would cut other programs with already established effectiveness. If this happens, it is likely that many of these concepts will again be introduced in new legislation. In fact, some members of congress are already considering legislation that would re-invent these programs.

Rather than rescinding the already minimal appropriation for educational technology, it is suggested that Congress increase appropriation to the amounts authorized. Furthermore Congress should introduce and support telecommunications policies and legislation that provide incentives and special consideration for including education as one of the most critical components of the NII. There is more than enough evidence to justify a strong federal role in ensuring that all citizens have access to information and education on the National and Global Information Highway. It is clear that the states alone cannot make this happen.

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